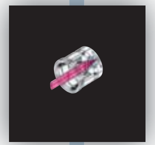
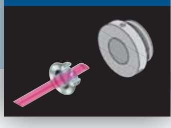
Modular Laser Diode Collimation Systems

Line and Micro Focus Optics 5...

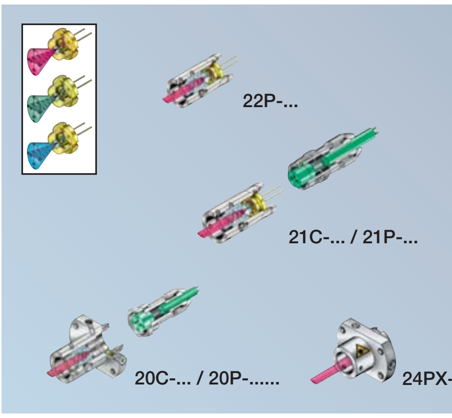
Collimation Lens



Adapter

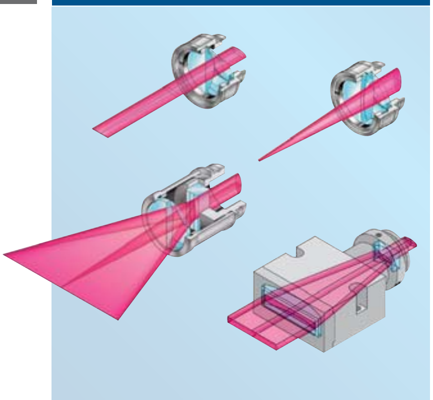


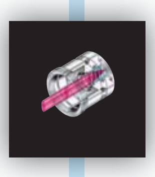
Collimators 20C-.../20P-... 21P-... / 22P-... (page 77f)



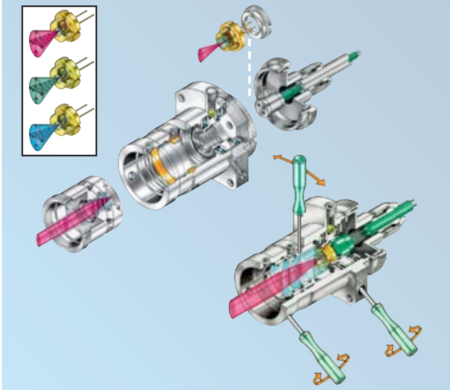
Modular system without any electronics for laser diodes with a Ø≤9 mm casing. Solderless contacts for the laser diode. Expandable using micro focus and micro line optics series **5...**

Line and Micro Focus Optics 13...



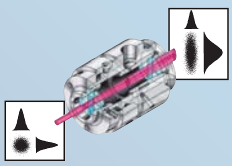


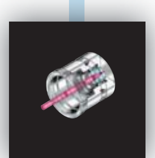
Collimators 50BM-... (page79ff)



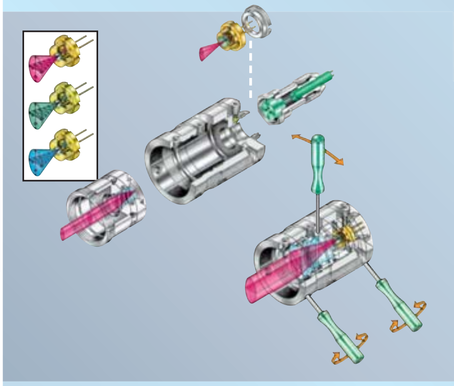
Modular system without any electronics for laser diodes with a Ø ≤9 mm casing. Easy adjustment of the laser diode and optics. Expandable using micro focus and micro line optics series **13...** Suitable for fiber coupling and for laser diodes with P_{out} <120 mW.

Anamorphic beam shaping optics 5AN...



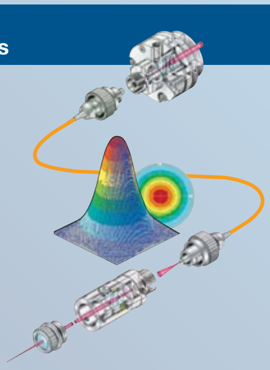


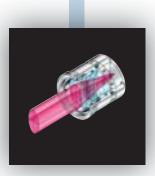
Collimators 55BC-... (page 82)



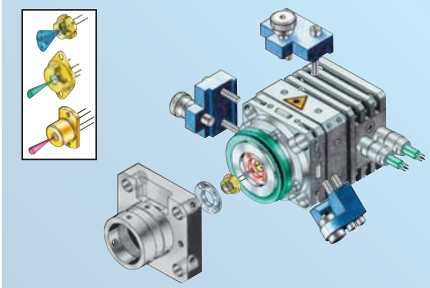
Modular system without any electronics for laser diodes with a Ø ≤ 9 mm casing. Good thermal dissipation. Expandable using micro focus and micro line optics series **13...** Suitable for fiber coupling. Customized features available on request.

Fiber Optics



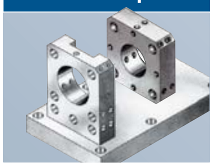


Collimators 48TE-SOT-..., 48-0-..., 44TE-... (page 83ff)



Modular system for self-assembly and adjustment of all established laser diodes. Optional thermo-electric cooling. Microbench compatible. Suitable for fiber coupling or for integration of anamorphic optics or a Faraday Isolator.

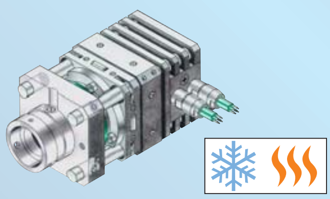
Mounting and Microbench plates



Laser safety glasses

Optional with:

Faraday Isolator FI-5...



Kollis_20C_Titel_LaserLines.indd • Page 76

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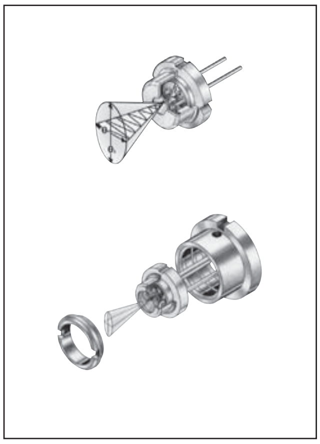
Physics Fundamentals: Laser Diode Characteristics

Laser Diodes

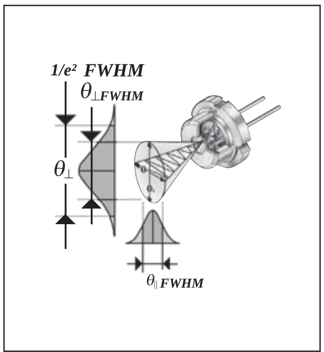


Laser Diodes are semiconductor lasers and are available in many different shapes and sizes with laser powers ranging from a few mW to hundreds of watts.

The emitted wavelength depends mainly on the semiconductor material of the laser diode cavity and laser diodes are produced to cover the full visible spectrum from blue to red, and even beyond, with some emitting in the infrared.

The laser diodes distributed by **Schäfter+Kirchhoff** cover the whole wavelength range from 370 nm to 2300 nm.

Divergence and Polarization

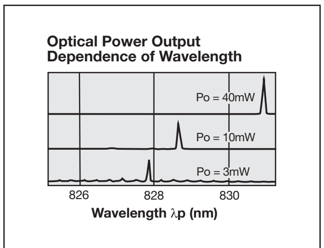


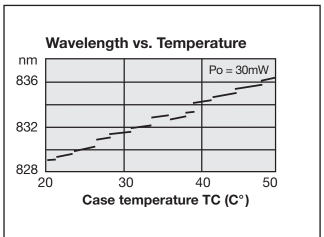
The microscopic cross-section of the laser diode active area of 1 x 3 µm results in emitted radiation that is divergent. Most laser diodes have a cone of divergent radiation with an elliptical cross-section and an approximately Gaussian intensity distribution. The ellipticity can be overcome with the help of anamorphic optics.

Some diodes (e.g. **VCSEL** or **Circular Laser**) are designed to produce a circular beam profile.

The polarization of the emitted radiation is linear and is parallel to the active area of the diode. The degree of polarization varies with the diode current and is lowest at the threshold.

Temperature and Power Dependence





The emitted spectrum is influenced by the diode temperature and diode current, as well as the geometry of the laser cavity. The front face and the end face serve as a Fabry-Perot cavity allowing multiple longitudinal modes.

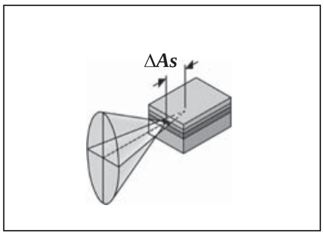
When operated just over the threshold, the diodes have a wavelength spectrum with equidistant peaks (longitudinally **multimode**). On increasing the diode current (to produce a higher power output), one of the longitudinal modes is usually favored and the diode emits in (longitudinally) **singlemode**.

Unfortunately, the gain profile and the refractive index of the semiconductor material are temperature dependent and, so, other longitudinal modes can be amplified and the output wavelength changes rapidly, by up to a few nanometers, resulting in **mode hopping**.

For a non-stabilized singlemode diode, mode hopping occurs stochastically and the emitted wavelength and output power can change erratically by as much as 3%. For a temperature range of 20 to 30°C, the center wavelength can drift by 2.5–3 nm (GaAs).

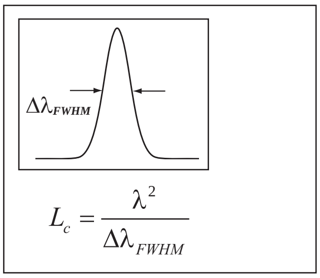
Since changing the diode current changes the diode temperature, the current/power output dependence of the laser diode is only nominal. When the laser power is increased from the threshold up to the nominal power then the wavelength increases by 2–4 nm.

Astigmatism



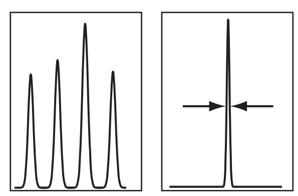
The non-uniform gain profile within the active layer of the laser diode means that some laser diodes show astigmatism. Here, the laser radiation emitted parallel and perpendicular to the active layer does not emerge from one point at the cavity end, but appears to be emerging from two different positions. The distance between these is called the astigmatic difference ΔAs and is between 3–40 µm. Astigmatism can be corrected by using anamorphic optics (**5AN-...**).

Coherence



The particular application determines whether a long coherence L_c (here given for a Gaussian spectrum) or a short coherence is desirable. Non-stabilized singlemode lasers with stochastic changes of the wavelength also exhibit stochastic changes in coherence behavior. **Superluminescent diodes** use incoherent spontaneous emission to provide short coherence. For interferometry or spectroscopy, a long (or sufficient) coherence is essential, a feature of **DFB, DBR VCSEL** diodes with integrated or external thermo-electric cooling (TEC).

Wavelength Constancy



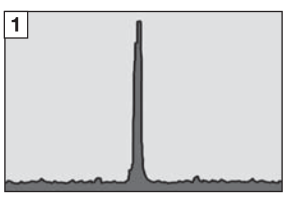
Non-stabilized singlemode diode — Narrow tunable DFB spectrum

The emitted wavelength can be kept constant in a number of ways. External temperature control is possible using integrated or external Peltier elements and temperature sensors (see **48TE SOT-...**). Most laser diodes also have an integrated monitor photodiode, providing feedback for control of the laser power.

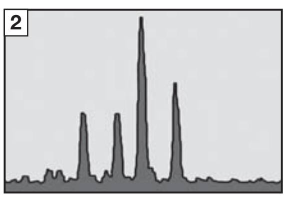
The use of **DFB (distributed feedback)** or **DBR diodes (distributed Bragg reflector)** with their spectrally very narrow lines can be advantageous. With the help of a grid structure, only one longitudinal Fabry-Perot mode is amplified (stable singlemode) and mode hopping is suppressed.

VCSEL diodes use DBR structures to produce very narrow lines. The temperature dependence remains, however, and a constant wavelength can only be provided by using an integrated or external temperature control system with integrated monitoring photodiode.

Lifetime and Low Noise Operation



Faraday isolator prevents back-reflection and the diode spectrum is undisturbed



Mode hopping from destabilization of the diode by back-reflections

Laser diodes are very sensitive, especially when exposed to an electrostatic discharge. Surges in the current or voltage can damage a diode severely, making extremely stable power sources a necessity. The life expectancy of the diode is increased at lower diode temperatures and power outputs, making it very important to operate the diode below its maximum current.

Faraday Isolators (**48FI-5-...**) can effectively prevent back-reflection into the diode [1].

Back-reflections can cause mode hopping [2] and instabilities in the diode wavelength as well as the power output that, in turn, result in faster degradation of the performance and to disturbance of the polarization.

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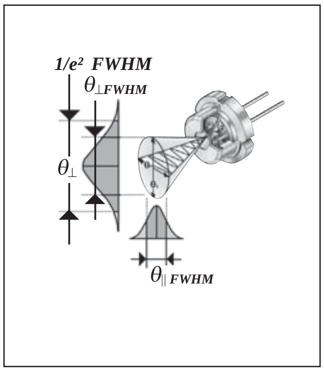
Laser Collimation and Overview of Laser Diodes

Laser Collimation



The beam can be characterized by the divergence $\theta_\perp$ x $\theta_\parallel$ measured perpendicular and parallel to the active surface area at the 1/e²-level (= 13.5%).
Beam characteristics can also be described at the 50% intensity level and are then defined by the divergence $\theta_{\perp FWHM}$ x $\theta_{\parallel FWHM}$ (FWHM: full-width at half-maximum).

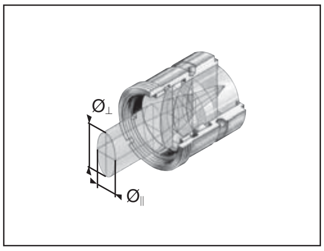
For laser diodes, the parameters $\theta_{\perp FWHM}$ x $\theta_{\parallel FWHM}$ are usually specified and for a collimated beam, a description at the 1/e²-level is more suitable.

Collimation optics transform a divergent beam with the divergence $\theta_\perp$ x $\theta_\parallel$ into a collimated beam, retaining both its Gaussian intensity distribution and elliptical beam profile with diameters $\varnothing_\perp$ x $\varnothing_\parallel$. The beam diameter $\varnothing_{\perp,\parallel}$ at the collimator is also given at the 1/e²-level and is defined by the focal length f of the collimating lens and the divergence $\theta_{\perp,\parallel FWHM}$ of the laser diode.
These differing definitions are responsible for the factor 1.7 in the equations above.

$$\varnothing_\parallel = 2 \cdot f \cdot \sin\left(\frac{1}{2} \cdot \theta_{\parallel FWHM} \cdot 1.7\right)$$

$$\varnothing_\perp = 2 \cdot f \cdot \sin\left(\frac{1}{2} \cdot \theta_{\perp FWHM} \cdot 1.7\right)$$

f = focal length of collimating lens
$\varnothing_{\perp,\parallel}$ = beam diameter (13.5%-level)
$\theta_{\perp,\parallel FWHM}$ = laser diode beam divergence (50%-level)



Even a collimated beam exhibits minimal divergence, since the beam diameter varies (for large distances) with the distance A from the laser diode collimator. The resulting beam divergences of the collimated beam $\vartheta_\perp$ and $\vartheta_\parallel$ depend on the respective beam diameters at the collimator $\varnothing_\perp$ and $\varnothing_\parallel$ and on the wavelength λ of the emitted radiation. For an ideal Gaussian beam (M² = 1):

$$\vartheta_{\perp/\parallel} = \frac{2 \cdot \lambda}{\pi \cdot \varnothing_{\perp/\parallel}}$$

$\vartheta_{\perp,\parallel}$ = beam divergence of the collimated beam
$\varnothing_{\perp,\parallel}$ = beam diameter (13.5%-level)
λ = wavelength

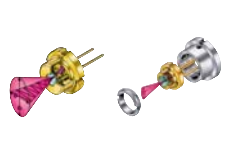
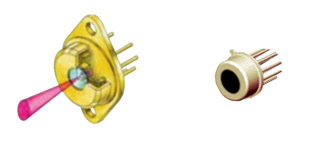
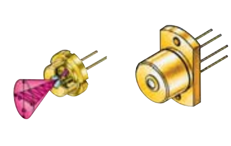
Collimating Lenses

The collimating lenses from **Schäfter+Kirchhoff** are manufactured from high quality glass. Beam collimation and beam shape are up to 30x more stable in comparison with plastic lenses, which exhibit variations in refractive index and shape with changes in temperature.

Bi-asphere lenses are used for collimating monochromatic radiation and exhibit the same correction and imaging quality as microscope lenses with three or four elements. The particular manufacturing process produces micro structures on the lens surface, which are manifest in the collimated beam but not in a focussed spot. Triplet lenses are three lens systems of spherical elements with high quality surfaces that provide a substantial level of spherical correction and a high numerical aperture.

In the wavelength range 370–2300 nm, lenses are provided with an individual anti-reflex coating that cover a few hundred nm of bandwidth.

Overview of Laser Diodes

Component									
Type of diode	Fabry Perot		DFB / DBR		**Integrated TEC/NTC**		VCSEL	Circular Laser	
Case type	Ø9	Ø5.6	TO3	TO5	Ø9	TOW 2	TO46	Ø9	Ø5.6
Integrated TEC/NTC	without	without	with and without	with and without	without	with	with and without	without	
Description	Fabry-Perot laser diodes possess a good price-performance ratio because they are one of the commonest types of laser diode and they have a simple edge-emitting structure.		Distributed feedback (DFB) laser diodes have an integrated grating within the active medium while the grating structure for DBR diodes is outside of the active area. The emission bandwidth is narrow since the emission wavelength can be tuned by modifying either the applied current or the diode temperature.		Superluminescent diodes are characterized by spontaneous emission, producing a larger emission bandwidth with lower coherence length.		Vertical cavity surface-emitting laser diodes are inexpensive to produce. The beam profile is circular and the emission band-width narrow.	Circular Laser diodes have integrated internal beam-correcting (anamorphic) optics that produce a circular beam profile.	
Wavelengths									
390 – 515 nm	x	x							
633 – 700 nm	x	x			x	x	x	x	x
700 – 1100 nm	x	x	x	x	x	x	x	x	x
1100 – 2300 nm			x	x			x		
Emission bandwidth	narrow	narrow	very narrow	very narrow	broad	broad	very narrow	narrow	narrow
Coherence	varying	varying	long	long	short	short	long	varying	varying
Beam and spot profile	elliptical	elliptical	elliptical	elliptical	elliptical	elliptical	circular	circular	circular

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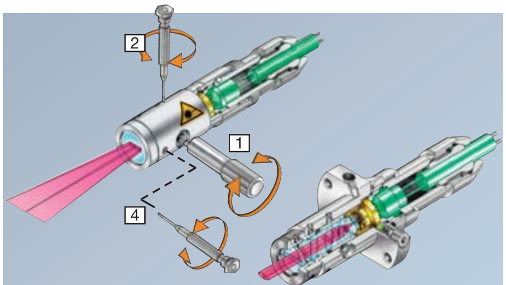
Laser Diode Collimators 20-... / 21-...

Compact modular system without any electronics



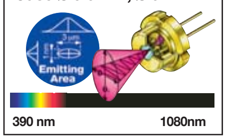
1 Focusing of the collimating lens with eccentric key
2 Locking of the collimating lens with screwdriver
3 Beam-shaping optics series 5x-...
4 Alignment and positive locking of beam-shaping optics with screwdriver (order code 9D-12)

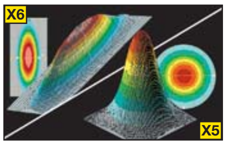
A laser diode collimator transforms the divergent radiation of a laser diode into a collimated (parallel) beam. The beam profile is elliptical X6 or circular X5 and is defined by the beam characteristics of the laser diode. The parallel and perpendicular beam dimensions can be calculated from the beam divergence of the laser diode and the numerical aperture and focal length of the collimating lens (page 15).

Features:

- **Compact, modular system without any electronics**
- **Suitable for diodes of Ø 9 mm (Ø 5.6/3.8 mm with adapters, p. 78)**
- **Internal focussing mechanism**
- **Large variety of collimating lenses with focal lengths f' 4–11 mm**
- **The collimating lenses are manufactured from high quality glass – the collimation and beam shape are 30 times more stable compared with plastic lenses, which show variation in refractive index and shape with changes in temperature.**
- **Large variety of laser diodes (page 94)**
- **Diode galvanically isolated (type C), or diode potential on casing (type P)**
- **Option: cable plug system**
- **Frontal slot for fitting micro focus and micro line optics**

Laser diodes 390–1080 nm
Case Ø 5.6 mm, Ø 9 mm

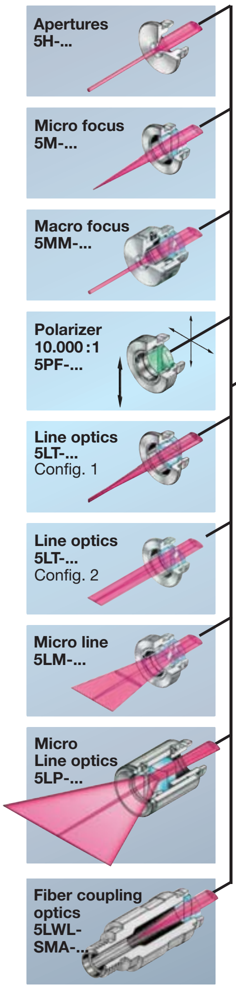




Please choose the laser diodes according to Table 1 on page 94 and collimating lenses according to Table 1 on page 78.
Focus adjustments with the micro focus or laser line systems are performed by adjusting the collimating lens.

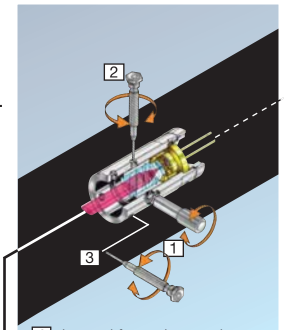
Attachable Beam-shaping optics

Beam-shaping optics transform the collimated beam into micro spots or laser lines.
For details see pages 22-66.

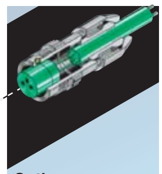


Laser Diode Collimator 21...

Mounted by Schäfter+Kirchhoff



1 internal focussing mechanism using eccentric key 60EX-4
2 locking of the focus setting using screwdriver 9D-12
3 positive locking of beam-shaping optics (9D-12)



Option:
Cable plug system 21CS/21PS
... for solderless contact of laser diode pins (page 78)

- **Not suited for costumer mounting and alignment**
- **Collimating lenses with focal lengths f' 4–11 mm (details on page 78)**
- **Suitable for diodes of Ø 9 mm (Ø 5.6/3.8 mm with adapter, p. 78)**
- **With internal focussing mechanism**
- **Frontal slot for fitting micro focus and micro line optics**
- **Option: cable plug system 21CS/21PS for solderless contact of pins (p. 78)**

Order Code 21 C - A8 - 07 - 660 - M01 - 0

Laser diode mounting
C = galvanically isolated
P = diode potential on casing

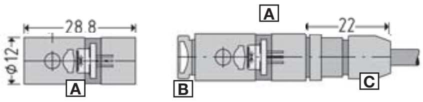
Collimating lens and AR-Coating (Table 1, page 78)

Wavelength and LD-Code (page 94)

Cable options:
0 = w/o plug system 21CS/21PS
1 = with shielded cable plug system 21CS/21PS, 1.5 m
4 = cable as in 1, with 4-pin connector (Lemo) for laser diode power supply SK 9735C/SK9735C2
5 = cable customer-specific

Components and tools on page 78.

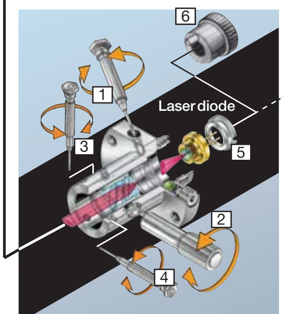
Dimensions



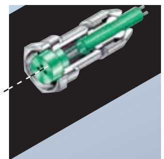
Laser Diode Collimator 21... A with attachable beam shaping optics B and cable plug system C

Laser Diode Collimator 20...

Modular system for the customer assembly and alignment of laser diodes



1 x/y-adjustment of laser diode using screwdriver 9D-12
2 internal focussing mechanism using eccentric key 60EX-4
3 locking of the focus setting using screwdriver 9D-12
4 positive locking of beam-shaping optics (9D-12)
5 threaded ring
6 mounting key for LD (50LD-C or 50LD9.0, p. 78)



Option:
Cable plug system 20CS/20PS
... for solderless contact of laser diode pins (p. 78)

- **Collimating lenses with focal lengths f' 4–11 mm (details on page 78)**
- **Suitable for diodes of Ø 9 mm (Ø 5.6/3.8 mm with adapter, p. 78)**
- **With internal focussing mechanism**
- **Collimator casing permits lateral x/y-adjustment of laser diode using screwdriver 9D-12**
- **Frontal slot for fitting micro focus and micro line optics**
- **Option: cable plug system 20CS/20PS for solderless contact of pins (p.78)**

Order Code 20 C - A4 - 01 - 405 - X05 - 1

Laser diode mounting
C = galvanically isolated
P = diode potential on casing

Collimating lens and AR-Coating (Table 1, page 78)

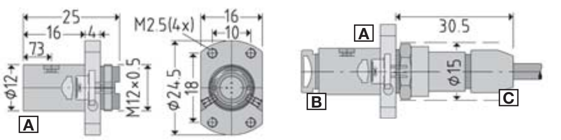
Wavelength and LD-Code (page 94)

Cable options:
0 = w/o plug system 20CS/20PS
1 = with shielded cable plug system 20CS/20PS, 1.5 m
4 = cable as in 1, with 4-pin connector (Lemo) for laser diode power supply SK 9735C/SK9735C2
5 = cable customer-specific

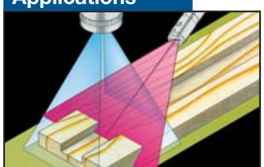
Components and tools on page 78.

Dimensions

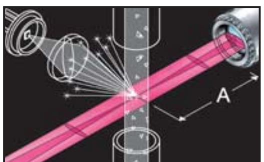
Laser Diode Collimator 20... A with micro focus optics B and cable plug system C



Applications

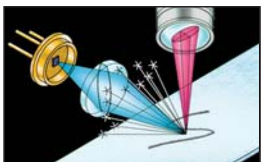


3D Contour Measurement



Particle measurement

e.g. for AFM Microscopes



Scratch detector

Genetic Engineering

Schäfter+Kirchhoff

Laser Diode Collimators / Components and Tools

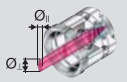
Compact modular system without electronics

Collimating lenses for Laser Diode Collimators 20..., 21...

The collimating lenses are manufactured from high quality glass – the collimation and beam shape are 30 times more stable compared with plastic lenses, which show variation in refractive index and shape with changes in temperature.

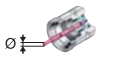
Table 1	Beam parameters		Collimating Lens						
row	curr. no		1	2	3	4	5	6	7
	Collimation lens		20CL						
1	Lens type 1)		A4**	A4	A4.5	T5	A6.2	A7.5	A8
2	Focal length f'		4	4	4.5	5	6.2	7.5	8
3	Numerical aperture NA		0.6	0.6	0.55	0.5	0.4	0.3	0.3
4	Clear aperture [mm]		4.8	5	4.95	5	5	6.5	4.8
5	Max. active area [mm]		0.05	0.05	0.18	0.14	0.2	0.1	0.1
6	Lens for UHV application		x	x	x		x	x	x
	Spectral range	Code no. of AR coating							
7	350 - 460 nm	52	52					52	
8	400 - 600 nm	01	01		01		01	01	
9	600 - 1050 nm	02	02		02		02	02	
10	1050 - 1550 nm	03	03		03		03	03	
11	1300 - 1750 nm	45			45		45		
12	650 - 1150 nm	07							07
13	390 - 670 nm	33							
14	600 - 1020 nm	05				05			
15	630 - 980 nm	10							
16	830 - 1550 nm	25							
17	1550 - 1750 nm	22			22		22		
18	1750 - 2300 nm	09			09		09	09	
20	980 - 1550 nm	08							
21	1750-3000 nm	64		64*					

Beam parameters for the collimated laser beam are calculated using the formulas 1-3 on page 15. Two specific examples are shown below:



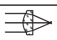
Beam parameter for the collimated laser beam using a 670 nm laser diode with active area 0.1 x 3 µm and beam divergence 10°x 30° (FWHM), beam-Ø 1/e² (13.5%), # beam cross-section restricted by lens aperture

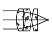
row		1	2	3	4	5	6	7
18	beam-Ø ‖ [mm]	1.2	1.2	1.3	1.5	1.8	2.2	2.4
19	beam-Ø ⊥ [mm]	3.4	3.4	3.9	4.3	#5.0	#6.5	#4.8
20	divergence ‖ [mrad]	0.36	0.36	0.32	0.29	0.23	0.19	0.18
21	divergence ⊥ [mrad]	0.12	0.12	0.11	0.1	0.09	0.07	0.09



Beam parameter for the collimated laser beam using a 635 nm CircuLaser™ diode with beam divergence 8°x 8° (FWHM)

row		1	2	3	4	5	6	7
22	beam-Ø 1/e² (13.5%) [mm]	0.9	0.9	1.1	1.2	1.5	1.8	1.9
23	divergence [mrad]	0.43	0.43	0.38	0.34	0.28	0.24	0.21

1) A = aspheric lens 

T = triplet 

*) IR chalcogenide lens

**) Lens no. 1 (A4-01)
Bi-asphere f=4 mm, NA 0.6.:
optimized for the collimation of
405 nm laser diodes.

Collimation lens 20C - **A4 - 01** - 405 - X05 - 1

Lens type, see Table 1, row 1 — AR-coating, see Table 1, row 7-21

Laser Diodes

Please choose your laser diode according to Table 1 on page 94 of the catalog. Other diodes are available on request.
The laser diode collimators of series 20... and 21... can also be supplied with customer-owned laser diodes. Please contact Schäfter+Kirchhoff if these are not part of our product portfolio since specific features (e.g. point of emission, etc.) about the laser diode need to be known beforehand in order to ensure compability with the laser diode collimator.

Assembly Tools

For laser diode mounting in collimators **20C-... 21C-...**

Mounting key Order Code **50LD-C**

For laser diode mounting in collimators **20P-... 21P-...**

Mounting key Order Code **50LD9.0**

Adjustment screws

Order Code **20AS-01** (set = 3 pcs.) for laser diode adjustment in collimator **20C-...**

Screwdriver Order Code **9D-12** Ø 1.2 mm for lens locking and beam-shaping optics

Eccentric key Order Code **60EX-4** for lens focusing

Cable Plug System

- For solderless contact with the laser diode pins
- For collimators **20..., and 21...**

Cable Plug System 20CS...

Order Code **20 CS - 3 - 150 - 4**

Cable Plug System for:
20CS = Collimator 20C
20PS = Colllimator 20P
21CS = Collimator 21C
21PS = Collimator 21P

Diode Pin-Out/Cable:
3 = for 3-pin diode (see Pin-out p. 96), shielded cable (Type 3x AWG 26C UL sw, 0.14mm²)
4 = for 4-pin diode (see Pin-out p. 96), shielded cable (Type 4x AWG 26C UL sw, 0.14mm²)

Connector:
4 = with 4-pin connector for Power Supply from Schäfter+Kirchhoff (Type LEMO=FGG.0B.304)
5 = customer-specified configuration
0 = cable end shortened

Cable length:
Length in cm (standard=150)

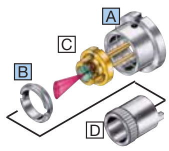
Adapters for Laser Diodes

Laser diodes of Ø 5.6 / Ø 3.8 mm size can be inserted into the slot for laser diodes of Ø 9 mm size without altering the active area nor its position: the laser diode beam axis and the position of the emitter are unchanged.

Adapter: Order Code **50AL-5.6**
2 parts: A Outer casing Ø 9 mm
B Retaining ring for laser diode

Adapter: Order Code **50AL-3.8**
2 parts: A Outer casing Ø 9 mm
B Retaining ring for laser diode

C Laser diode with casing Ø5.6 mm / Ø3.8 mm
D **Assembly key** Order Code 50LD5.6
Adapters for other diode casings on request.



Laser diode control and power supply

19"-cassette, constant current or constant power, modulation analog or digital, ESD protected. Max mod. frequency 100kHz (const. power), 50 kHz (const. current)

115/230 V AC with integrated linear power supply — Order Code **SK9735C2**

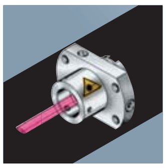
12 V AC — Order Code **SK9735C**

Special Configurations and Customer Solutions

For customized configurations of the laser diode collimator series 20..., 21... please contact Schäfter+Kirchhoff.

Laser Diode Collimator 24PX-...

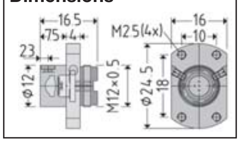
Modular system for customer mounting and alignment of laser diodes
Special design for use in ECL



Laser diode collimator 24PX...
Lens A3.1-... NA 0.68
A4-01 NA 0.6 (370–600 nm)
A4.5-... NA 0.55

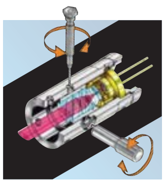
If not specified, AR coatings are available in the range 370 – 2300 nm each covering several 100 nm bandwidth (see table 1)

Dimensions



Laser Diode Collimator 22P-...

Special Configuration of Laser Diode Collimator 21...



- **Not suited for customer mounting/alignment**
- **x/y-adjustment of laser diode with special tool**
- **With internal focussing mechanism**
- **Frontal slot for fitting micro focus and micro line optics**

Dimensions

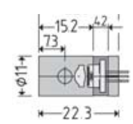


Table 2: Overview: Laser Diode Collimators 20..., 21..., 22P-... and 24PX-...

Compact modular system without electronics

Casing Ø [mm]	Focal Length [mm]	LD Customer Mounting/Alignment	Galv. isolation of laser diode	Cable Plug System	Flange	Focussable	Attachable beam shaping opics	Laser Diode Collimator
12	4-11	x/x	x/-	20CS/20PS	x/x	x	x	**20C-.../20P-...**
12	4-11	-/-	x/-	21CS/21PS	-	x	x	**21C-.../21P-...**
11	4-11	-	-		-	x	x	**22P-...**
12	3.1-4.5	x	-	20PS	x	x		**24PX-...**

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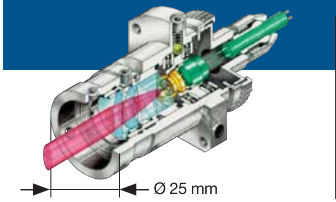
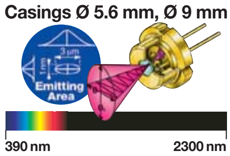
Laser Diode Universal Collimator 50BM-...



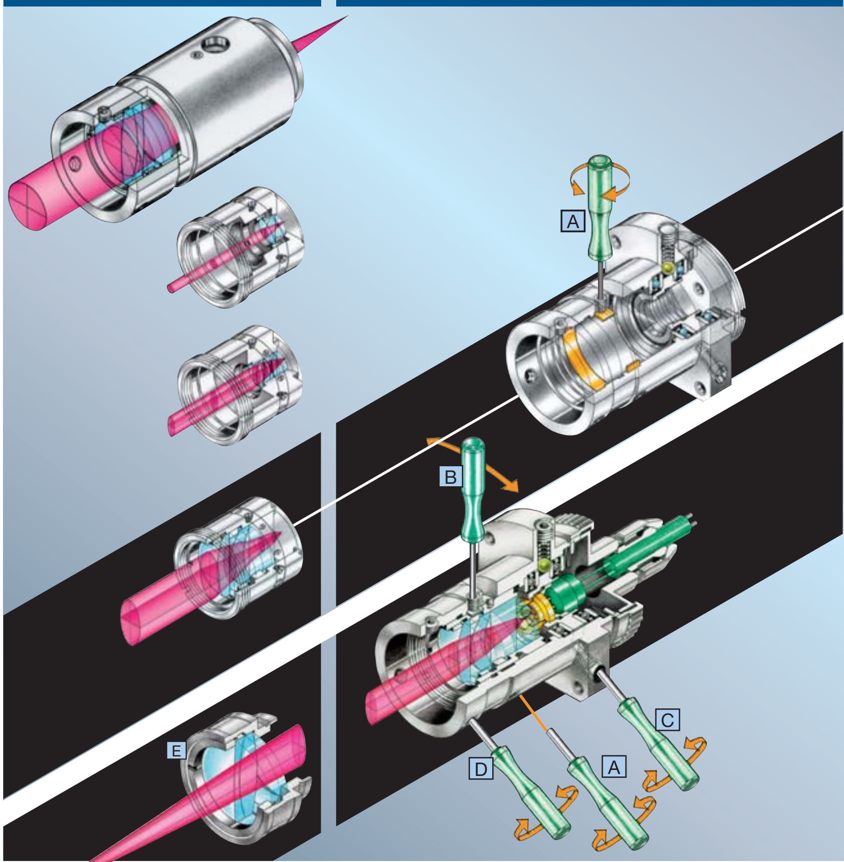
- Modular assembly system for the quick and precise mounting, adjustment and collimation of laser diodes 390–2300 nm
- Suitable for diodes of Ø 9 mm (Ø 5.6/3.8 mm with adapter, p. 80) and P<120mW
- Collimation of beam-shaping optics for the generation of micro focus and laser lines
- Laser beam coupling into polarization-maintaining singlemode fiber cable with mode field diameters (MFD) ≥2 µm

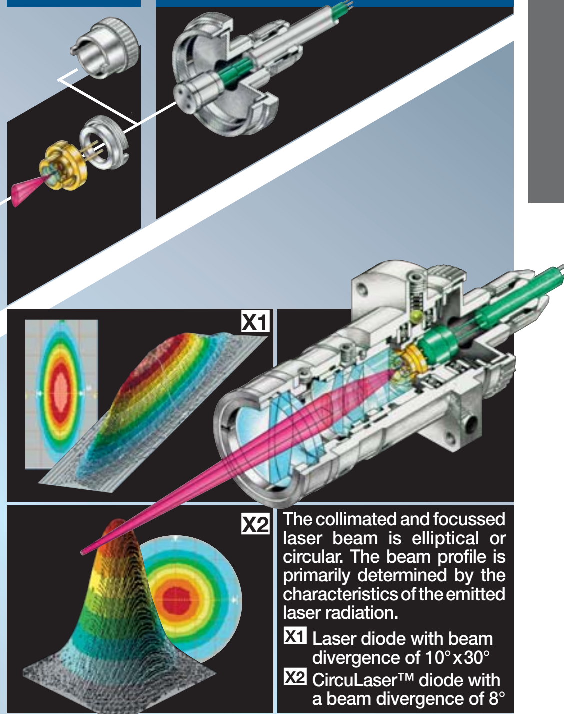
Laser diodes 390–2300 nm
Casings Ø 5.6 mm, Ø 9 mm



The universal laser diode collimator system 50BM-... with attached beam-shaping and fiber optics from Schäfter+Kirchhoff provides a range of laser system configurations with 1000s of combinations of laser beam-shaping optics for data transmission, medical applications, industrial measurement and sensor techniques, analysis, biosensors and nanotechnology.

Collimation lenses 50CL-... | Collimator basic unit 50BM-... | Laser diode | Cable connector system 50 CS-...





The collimated and focussed laser beam is elliptical or circular. The beam profile is primarily determined by the characteristics of the emitted laser radiation.

X1 Laser diode with beam divergence of 10°x30°

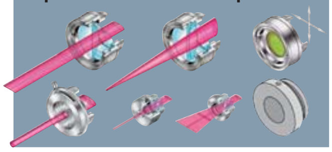
X2 CircuLaser™ diode with a beam divergence of 8°

A Lens locking (indirect clamping)
B Lens focussing by using the beam-shaping optics
C X/y-centering of the laser diode
D The beam-shaping optics or laser beam coupler are locked into position using radially located grub screws
E Attachable beam-shaping optics, here: 13M-...

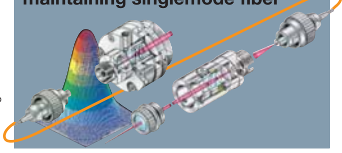
System extension components for attachment

Beam-shaping optics

Attachable optics for micro lines, elliptical or round micro spots 13-...



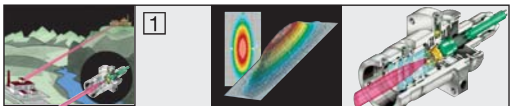
Fiber optics for a polarization-maintaining singlemode fiber



Laser diode control and power supply 9735C2

Applications: 8 of 1000s

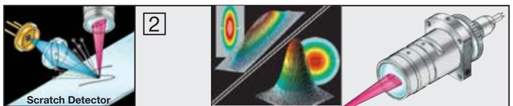
1



Laser Telemetry: Collimated laser beam option: Beam doubling gives redundancy in bad weather

Collimation lens 50CL-T12-10

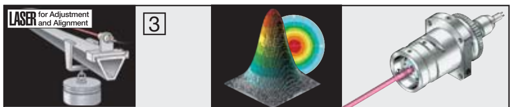
2



Scratch Detection
Laser collimator with microfocus optics

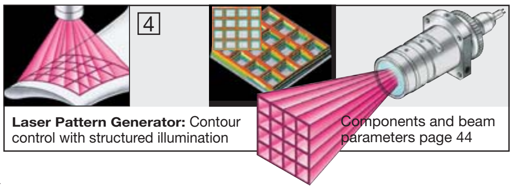
Components and beam parameters page 40

3



Pilot Beam
Collimated laser beam with CircuLaser™ diode

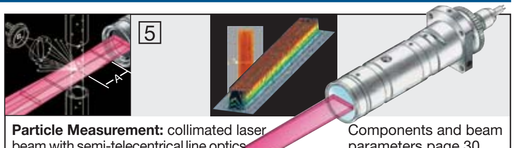
4



Laser Pattern Generator: Contour control with structured illumination

Components and beam parameters page 44

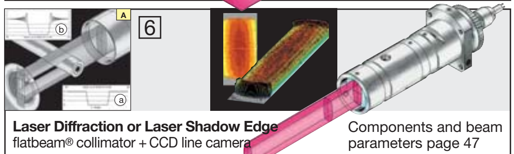
5



Particle Measurement: collimated laser beam with semi-telecentrical line optics

Components and beam parameters page 30

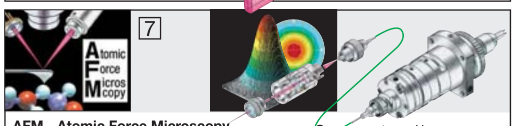
6



Laser Diffraction or Laser Shadow Edge
flatbeam® collimator + CCD line camera

Components and beam parameters page 47

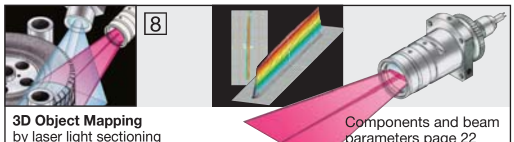
7



AFM - Atomic Force Microscopy
Laser beam coupling into a singlemode fiber

Components and beam parameters see fiber optics catalogue

8



3D Object Mapping
by laser light sectioning

Components and beam parameters page 22

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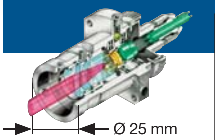
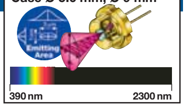
Universal Laser Diode Collimator 50BM-...

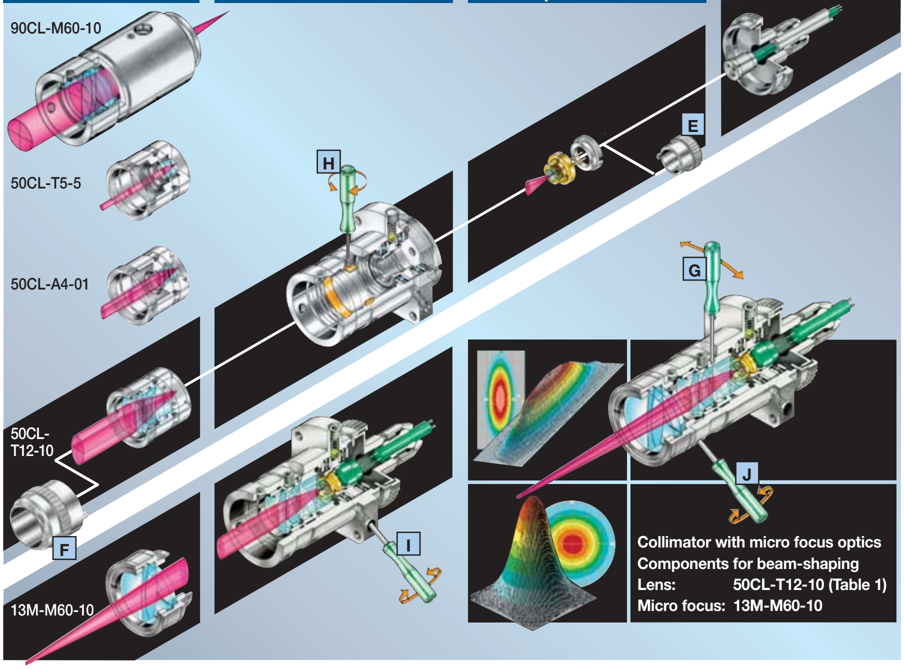


Collimation lenses transform the divergent laser radiation into a parallel beam. The beam parameters are determined by the focal length of the lens, its numerical aperture and the divergence of the initially emitted radiation. The original beam characteristics of the laser diode (elliptical or circular beam profile) are preserved.

Laser diodes 390 - 2300 nm
Case Ø 5.6 mm, Ø 9 mm

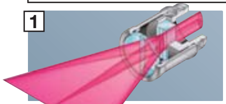


Collimation lenses 50CL-... [A]	Collimator basic unit 50BM-... [B]	Laser diode and adapter [C]	Cable connector system 50CS-... [D]

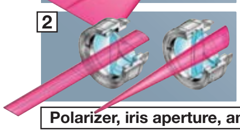


Components for system expansion

Line and microfocus optics 13-...

1 

Line optics 13LR25-S250
Laser line with constant linewidth,
edge intensity >80%

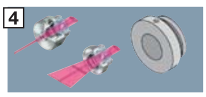
2 

Line optics 13 LT...,
semi telecentric laser line of constant line length
Micro focus optics 13M...
f 60 – 325 mm

Polarizer, iris aperture, and adapter

3 

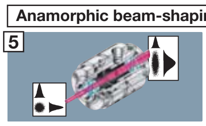
Iris aperture 13BL1-13
aperture Ø 1-13 mm
Polarizing filter 13PF-...
10.000 : 1

4 

Adapter 8AM-19.5
for beam-shaping optics 5...

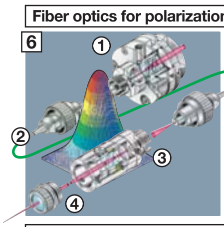
Beam-shaping optics 5...
for laser beam Ø 5 mm

Anamorphic beam-shaping optics 5AN...

5 

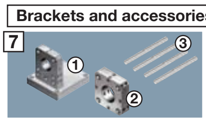
Afocal cylinder lens optics
- Integrated astigmatism correction
- Beam aperture: 5 mm

Fiber optics for polarization-maintaining singlemode fibers

6 

① Laser beam coupler **60SMS-...**
② Singlemode fiber cable, polarization-maintaining **PMC-...**
③ Fiber collimator **60FC-...**
④ Microfocus optics **5M-...**

Brackets and accessories

7 

Microbench compatible
① Bracket **48MB-19.5-60**
② Plate **48MC-MP-19.5**
③ Rods **48MC-6-...**

Laser diode control and power supply 9735C2

8 

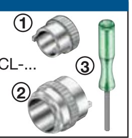
- 19" cassette 3HE / 10TE 133.3 x 50.8 x75 mm) for power supply 115/230 V
- Constant current or power operation
- Up to 250mA laser current output
- ESD protection
- Modulation digital and analog

Mounting and adjustment

[E] Laser diode mounting: fixed with threaded ring
Tool: **Assembly key 50LD9.0**
[F] Lens mounting and focussing
Tool: **Focussing key 50FL-03**
[G] Lens focussing with attached beam-shaping optics by left and right-hand turns of the collimation lens. Tool: **Allen hex key 50HD-15**
[H] Lens locking (indirect locking)
Tool: **Allen hex key 50HD-15**
[I] X/y-adjustment of the laser diode
Tool: **Allen hex key 50HD-15**
[J] Direct mounting and locking of beam-shaping optics and laser beam coupler
Tool: **Allen hex key 50HD-15**

Tools for mounting and adjustment

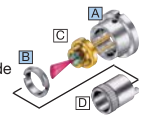
1 **Assembly key** for laser diode mounting
Order Code 50LD9.0
2 **Assembly key** for collimation lenses 50CL-...
Order Code 50LF-03
3 **Allen hex key** WS Ø 1.5 mm
Order Code 50HD-15



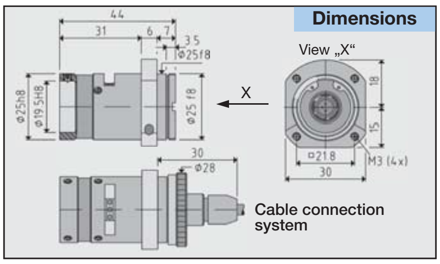
Adapter for Mounting Laser Diodes Ø5.6 /3.8 mm

Laser diodes of Ø 5.6/Ø 3.8 mm size can be inserted into the slot for laser diodes of Ø 9 mm size without altering the active area nor its position: the laser diode beam axis and the position of the emitter are unchanged.

Adapter Order Code **50AL-5.6**
2-parts: [A] Outer casing Ø 9 mm
[B] Retaining ring for laser diode
Adapter Order Code **50AL-3.8**
2-parts: [A] Outer casing Ø 9 mm
[B] Retaining ring for laser diode
[C] Laser diode with casing Ø5.6 mm / Ø3.8 mm
[D] **Assembly key** Order Code **50LD5.6**
Adapters for other diode casings on request



Dimensions



Modular assembly system for the rapid and precise mounting, adjustment and collimation of laser diodes

The universal laser diode collimator system 50BM-... has a robust size, and the ease of assembly and accessibility of adjustment and locking for it to be used in a wide range of both laboratory and industrial applications.

The **50BM-...** system is ideal for the self-assembly of laser diodes with 9 mm casings or smaller using the appropriate adapter. The galvanically decoupled ball bearing provides precise adjustment for laser diodes with lower power outputs of <120 mW and wavelengths <600 nm.

The **universal laser diode collimator system 55BC-...** is the system of choice when higher powers are required.

[A] Collimation lenses 50CL-...

- Transforms the divergent diode laser radiation into a parallel laser beam.
- Focal lengths from f' 4 mm to f' 60 mm (Table 1, page 81).
- AR coatings cover 350–2300 nm range, each with bandwidths of 250 to 600 nm.

[B] Collimator base 50BM

- Integrates laser diode, collimation lens and cable connection system for the laser current supply.
- Galvanically decoupled laser diode mounting with ball bearing (no freeplay). Precise x/y-adjustment of the laser diode, which is fastened using a threaded ring.
- Lens socket with cylindrical fit and fine thread. Internal lens focussing of 50CL: left or right-hand turn of the collimation lens provides a fine adjustment of the collimation or focus of the laser beam, even with attached beam-shaping optics.
- Frontal cylinder mounting with locking screws for the positive attachment of beam-shaping optics. The beam-shaping optics provide laser lines, micro focus optics or laser beam coupler for singlemode fiber cables.
- The laser module can be integrated into the microbench system using rods of Ø 6 mm with 30 mm pitch.

[C] Laser diode 600–2300 nm (page 94)

- The laser diode socket accepts laser diodes with Ø 9 mm casing and can also be used for the correct placement and centering of diodes with Ø 5.6 mm casing by using the **Adapter 50AL-5.6**.

[D] Cable connection system 50CS-...

- Electrically isolated, solderless, spring contacts for the laser diode. Cable housing with screw cap and integrated cord grip.

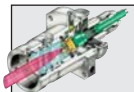
Cable Connection system 50CS...

50 CS - 3 - 150 - 4 Order Code

Connector:
4 = with 4-pin connector for Power Supply from Schäfter+Kirchhoff (Type LEMO=FGG.0B.304)
5 = customer-specified configuration
0 = cable end shortened

Cable length:
Length in cm (standard=150)

Diode Pin-Out/Cable:
3 = for 3-pin diode (see Pin-out p. 96), shielded cable (Type 3x AWG 26C UL sw, 0.14mm²)
4 = for 4-pin diode (see Pin-out p. 96), shielded cable (Type 4x AWG 26C UL sw, 0.14mm²)



Universal LD Collimator 50 BM-...

Order Code **50BM - T12 - 10 - 660 - M01 - 4**

Laser diode base
Collimator lens see Table 1, p.81
Laser diode
Wavelength and code see page 94
Cable connection system
1 = with cable connection system 50CS-1...
4 = with cable connection system 50CS-4...
5 = cable connection specified by customer

LD-Kolli_50BM_4seit_LaserLines.indd • Page 80

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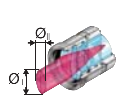
Collimation Lenses 50CL…

Table 1	Beam parameters		Collimation Lens 50CL-...											
row	curr. no		1**	2	3*	4	5	6	7	8	9	10*	11	12****
	Collimation lens		50CL											90CL
1	**Lens type 1)**		**A4**	**A4**	**A4.5**	**T5**	**A6.2**	**A7.5**	**A8**	**A8**	**T12**	**T12F**	**M12**	**M60**
2	Focal length f'		4	4	4.5	5	6.2	7.5	8	8	12.5	12.5	12.1	60
3	**Numerical aperture NA**		**0.6**	**0.6**	**0.55**	**0.5**	**0.4**	**0.3**	**0.3**	**0.5**	**0.54**	**0.54**	**0.22**	**0.14**
4	Clear aperture [mm]		4.8	4.8	4.95	5	5	6.5	4.8	8	13.5	13.5	5.5	17
5	Max. active area [mm]		0.05	0.05	0.18	0.14	0.2	0.1	0.1	0.1	0.2	0.2	0.2	0.2
6	Lens for UHV application		x	x	x		x	x	x	x	x	x		
	Spectral range		Code no. of AR coating											
7	350 - 460 nm	52	52					52						
8	400 - 600 nm	01	01		01		01	01		01				
9	600 - 1050 nm	02	02		02		02	02		02				
10	1050 - 1550 nm	03	03		03		03	03		03				
11	1300 - 1750 nm	45			45		45							
12	650 - 1150 nm	07							07					
13	390 - 670 nm	33											33	33
14	600 - 1020 nm	05				05								
15	630 - 980 nm	10									10		10	10
16	830 - 1550 nm	25												
17	1550 - 1750 nm	22			22		22			22				
18	1750 - 2300 nm	09			09		09	09		09				
20	980 - 1550 nm	08									08	08	08	
21	1750-3000 nm	64		64***										
18	beam-Ø ǁ [mm]		1.2	1.2	1.3	1.5	1.8	2.2	2.4	2.4	3.7	3.7	3.6	#17
19	beam-Ø ⊥ [mm]		3.4	3.4	3.9	4.3	#5.0	#6.5	#4.8	#6.9	10.8	10.8	#5.5	#17
20	divergence ǁ [mrad]		0.36	0.36	0.32	0.29	0.23	0.19	0.18	0.18	0.12	0.12	0.12	0.03
21	divergence ⊥ [mrad]		0.12	0.12	0.11	0.1	0.09	0.07	0.09	0.06	0.04	0.04	0.08	0.03
22	beam-Ø 1/e² (13.5%) [mm]		0.9	0.9	1.1	1.2	1.5	1.8	1.9	1.9	3.0	3.0	2.9	14.2
23	divergence [mrad]		0.43	0.43	0.38	0.34	0.28	0.24	0.21	0.21	0.14	0.14	0.14	0.03



Beam parameter for the collimated laser beam using a 670 nm laser diode with active area 0.1 x 3 µm and beam divergence 10°x 30° (FWHM), beam-Ø 1/e² (13.5%), (rows 18–21)

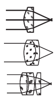
beam cross-section restricted by lens aperture

*** IR chalcogenide lens

**** Dimensions of fully assembled collimator differs

Beam parameter for the collimated laser beam using a 635 nm CircuLaser™ diode with beam divergence 8°x 8° (FWHM) (rows 22–23)

1) A = aspheric lens
M = laser monochromat
T = triplet



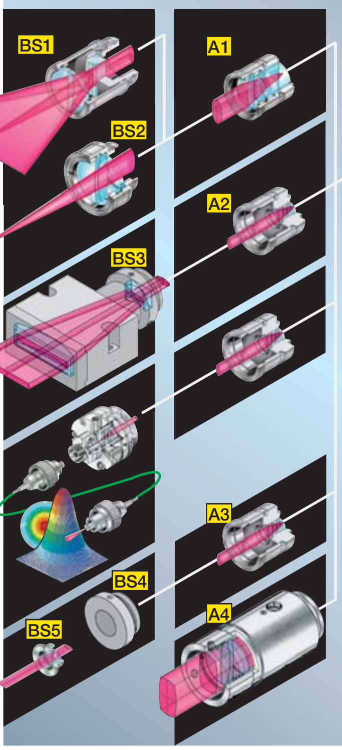
*) Lens no. 3 and 10: special lenses, optics design for laser diodes without terminating windows

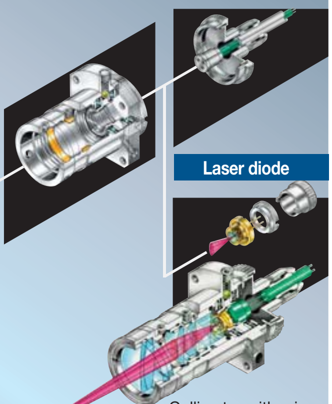
**) Lens no. 1 (50CL-A4-01)
Bi-asphere f 4 mm, NA 0.6, optimized for the collimation of 405 nm laser diodes.

Collimation lens 50CL-T12-05 Best.-Code
- AR coating, see Table 1
- Lens type, see Table 1

LD universal collimator system 50BM-...

BS Beam-shaping optics | A Collimation lenses 50CL-... | B Collimator base 50BM | D Cable connection system 50CS





Collimator with micro focus optics and beam parameters application no. 5

Adapter for laser diodes Ø 5.6 mm

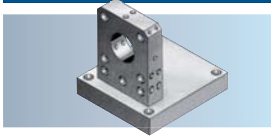
Application: Laser diodes with Ø 5.6 mm casing can be positioned correctly within the retainers for laser diodes with a Ø 9 mm casing using the adapter **50AL-5.6**

The laser diode beam axis and the position of the emitter do not change.

Adapter Order Code **50AL-5.6**

2 parts:
A Casing, outer Ø 9 mm
B Threaded ring for laser diode
C Laser diode with Ø 5.6 mm housing
D **Assembly key** Order Code 50LD5.6

Mounting Bracket



Bracket

Order Code **48MB-25-60**

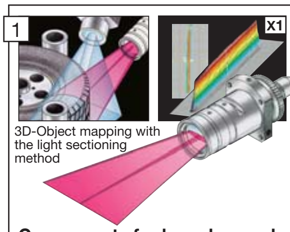
Microbench compatible (pitch: 30 mm, rods Ø 6 mm)

Laser Diodes

Please choose your laser diode according to table 1 on page 94 of the catalog. Other diodes are available on request.

Applications **Laser diode universal collimator 50BM-... with beam-shaping optics using the modular assembly system from Schäfter+Kirchhoff**

1



Laser micro line

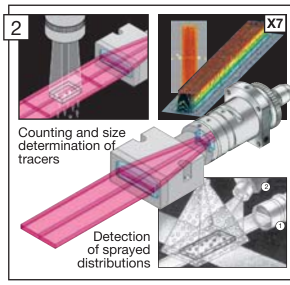
Lens combinations for lines with constant line-widths and homogeneous intensity distribution.

Emission angle: 25° (option: 12° or 40°)
Edge intensity: 80%
Working distance: 496 mm
Line length: 217 mm
Line width: 0.134 mm
Rayleigh range: 43 mm
Laser power: up to 40 mW

Components for laser beam shaping

Lens: A1 **50CL-T12-10** f=12.5, NA=0.54, AR 630-980 nm
Line optics: BS1 **13LR25-S500** Emission angle 25°, focal length f 500
Laser diode: M26 – 40 mW, 660 nm

2



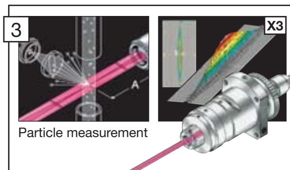
Telecentric laser band

Anamorphic cylinder lens optics
Beam width: 30 mm
Beam height: 1.3 mm (Option: 3 mm)
Beam divergence: 0.3 mrad
Edge intensity: 60 %
Laser power: 15 mW

Components for beam shaping

Lens: A2 **50CL-T5-05** Triplet f 5, NA 0.5
Anamorphic optics: BS3 **50AN 6-30**
Laser diode: N09 – 30 mW, 660 nm

3



Laser micro line

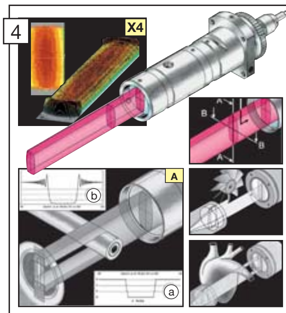
Semi-telecentric laser line with constant line length
Line length: 4.8 mm
Line width: 0.027 mm
Working distance: 74 mm
Rayleigh range: 1.7 mm
Edge intensity: 40%

Components for beam shaping

Lens: A3 **50CL-A8-07**, Asphere f8 NA 0.3, AR 650-1150 nm
Adapter: BS4 **8AC19.5**
Microline optics: BS5 **5LT75-1**
Laser diode: H10 – 10 mW, 635 nm

The beam height θǁ of the collimated laser beam is in focus. The line length remains constant.

4



Laser diode collimator flatbeam®

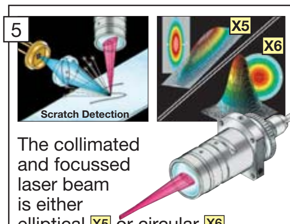
- Telecentric laser beam, X4 beam and intensity distribution
- **Beam divergence:** typ. 0.03 mrad
- **Beam aperture:** 17 mm (option: 37 mm)
- **Intensity distribution axis A-A:** flat top (rectangular)
- Edge intensity axis A-A > 80% (typ.)
- **Intensity distribution axis B-B:** Gaussian beam distribution

Components for beam shaping

Lens: A4 **90CL-M60-10** f 60 NA0.13-AR630-980 mm
Laser diode: H01 – 5mW, 633 nm

Application **Optoelectrical measurement system with laser diode collimator and CCD line scan camera:** Laser shadow edge or diffraction measuring system. High speed sensor technology for diameter or edge detection, position irregularities or contractions.

5



The collimated and focussed laser beam is either elliptical X5 or circular X6. The emitted beam profile is determined by the beam characteristics of the laser diode.

Laser micro focus

Gaussian intensity distribution X5 and X6 beam cross-section:
X5 elliptical with laser diodes θǁ 22° / θ⊥ 8.5°
X6 circular, aspect ratio 1.2 : 1

Beam cross-section	elliptical	circular
Focus-Ø:	0.006/0.015 mm	0.004 mm
Working distance:	54 mm	54 mm
Rayleigh range:	0.090 mm	0.030 mm
Components for beam shaping:		
Lens:	A1 50CL-T12-10 f 12.5 NA 0.54	A4 50CL-M60-10 f 60 NA 0.13
Micro focus optics:	BS2 13M-M60-10 f 60 NA 0.13	BS2 13M-M60-10 f 60 NA 0.13
Laser diode:	M26 – 39 mW, 660 nm	B07 – 15 mW, 635 nm

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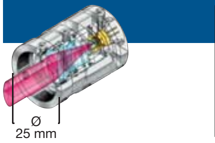
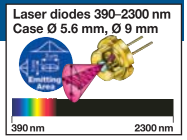
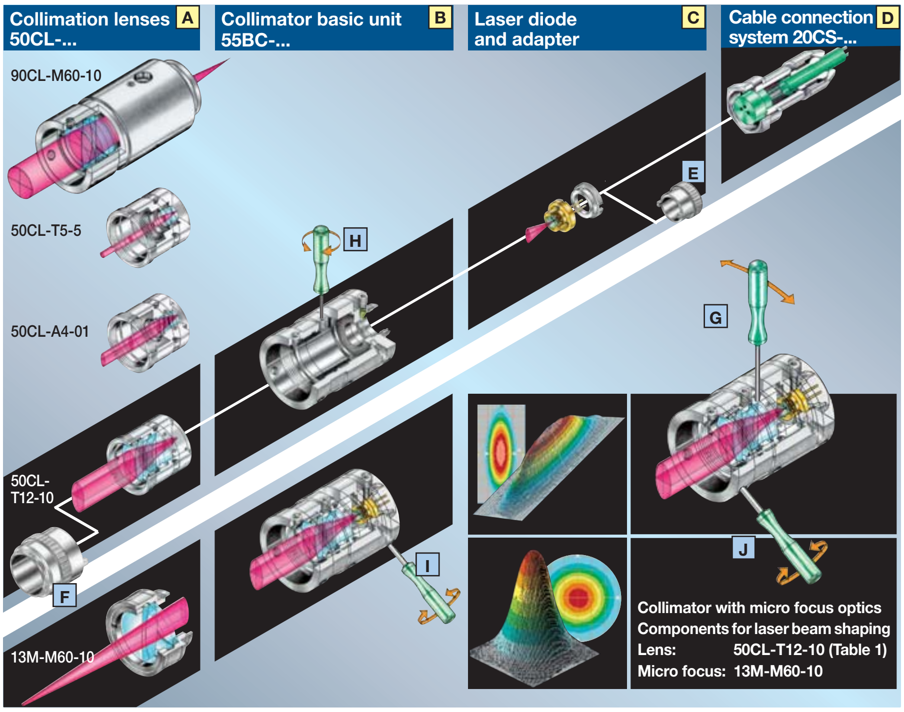
Universal Laser Diode Collimator 55BC-...



Collimation lenses transform the divergent laser radiation into a parallel beam. The beam parameters are determined by the focal length of the lens, its numerical aperture and the divergence of the initially emitted radiation. The original beam characteristics of the laser diode (elliptical or circular beam profile) are preserved.





Mounting and Adjustment

- E Laser diode mounting: fixed by a threaded ring
  Tool: **Assembly key 50LD-C**
- F Lens mounting and focussing
  Tool: **Focussing key 50FL-03**
- G Lens focussing with attached beam-shaping optics by a left or right-hand turn of the collimation lens
  Tool: **Allen hex key 50HD-15**
- H Lens locking (indirect locking)
  Tool: **Allen hex key 50HD-15**
- I x/y-adjustment of the laser diode
  Tool: **Allen hex key 50HD-15**
- J Direct mounting and locking of beam-shaping optics and laser beam coupler
  Tool: **Allen hex key 50HD-15**

Adapter for Mounting Laser Diodes Ø5.6 /3.8 mm

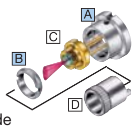
Laser diodes of Ø 5.6 mm / Ø 3.8 mm size can be inserted into the slot for laser diodes of Ø 9 mm size without altering the active area nor its position: the laser diode beam axis and the position of the emitter are unchanged.

Adapter Order Code **50AL-5.6**
2-parts: A Outer casing Ø 9 mm
B Retaining ring for laser diode

Adapter Order Code **50AL-3.8**
2-parts: A Outer casing Ø 9 mm
B Retaining ring for laser diode

C Laser diode with casing Ø5.6 mm / Ø3.8 mm
D **Assembly key** Order Code **50LD5.6**

Adapters for other diode casings on request

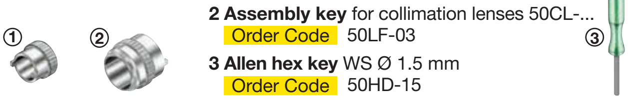


Tools for Mounting and Adjustment

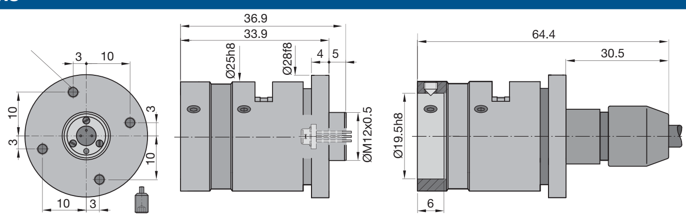
1 Assembly key for laser diode mounting
Order Code 50LD-C

2 Assembly key for collimation lenses 50CL-...
Order Code 50LF-03

3 Allen hex key WS Ø 1.5 mm
Order Code 50HD-15



Dimensions



Cable Plug System

For solderless contact of the laser diode pins

Order Code **20 CS - 3 - 150 - 4**

Diode Pin-Out/Cable:
3 = for 3-pin diode (see Pin-out p. 96) shielded cable (Type 3x AWG 26C UL sw, 0.14mm²)
4 = for 4-pin diode (see Pin-out p. 96) shielded cable (Type 4x AWG 26C UL sw, 0.14mm²)

Connector:
4 = with 4-pin connector for Power Supply from Schäfter+Kirchhoff (Type LEMO = FGG.0B.304)
5 = customer-specified configuration
0 = cable end shortened

Cable length:
Length in cm (standard=150)

Cable Plug System 20CS...

Modular assembly system for the rapid and precise mounting, adjustment and collimation of laser diodes

The universal laser diode collimator system 55BC-... has a robust size, and the ease of assembly and accessibility of adjustment and locking for it to be used in a wide range of both laboratory and industrial applications.

The **55BC-...** system is suited for laser diodes with 9 mm casings or smaller using the appropriate adapter. The laser diode is mounted galvanically decoupled and can be adjusted with high precision.

The **55BC-...** has a good heat dissipation and is thus suitable for diodes with higher power output >120 mW and wavelengths down to the UV.

A Collimation lenses 50CL-...

- Transforms the divergent diode laser radiation into a parallel laser beam.
- Focal lengths from f' 4 mm to f' 60 mm (Table 1, page 81).
- AR coatings cover 390–2300 nm range, each with bandwidths of 250 to 600 nm.

B Collimator basic unit 55BC

- Integrates laser diode, collimation lens and cable connection system for the laser current supply.
- Galvanically decoupled laser diode mounting. Precise x/y-adjustment of the laser diode, which is fastened using a threaded ring.
- Lens socket with cylindrical fit and fine thread. Internal lens focussing: left or right-hand turn of the collimation lens provides a fine adjustment of the collimation or focus of the laser beam, even with attached beam-shaping optics.
- Frontal cylinder mounting with locking screws for the positive attachment of beam-shaping optics. The beam-shaping optics provide laser lines, micro focus optics or laser beam coupler for singlemode fiber cables.
- The laser module can be integrated into the microbench system using rods of Ø 6 mm with 30 mm pitch.

C Laser diode 390–2300 nm (page 94)

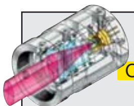
- The laser diode socket accepts laser diodes with Ø 9 mm casing and can also be used for the correct placement and centering of diodes with Ø 5.6 mm casing by using the **Adapter 50AL-5.6**.

D Cable connection system 20CS-...

- Electrically isolated, solderless, spring contacts for the laser diode.

Laser diode control/power supply SK9735C2

- 19“ cassette 3HE / 10TE 133.3 x 50.8 x75 mm) for power supply 115/230 V
- Constant current or power operation
- Up to 250mA laser current output
- ESD protection
- Modulation digital and analog



Universal LD Collimator 55 BC-...

Order Code **55BC-T12-10-660-M01-4**

Laser diode base
Collimator lens see Table 1, p.81
Laser diode
Wavelength and SK-code see last page
Cable connection system
1 = with cable connection system 20CS-1...
4 = with cable connection system 20CS-4...
5 = connection specified by customer

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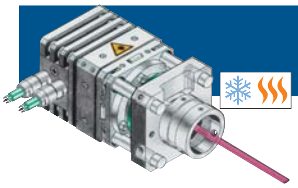
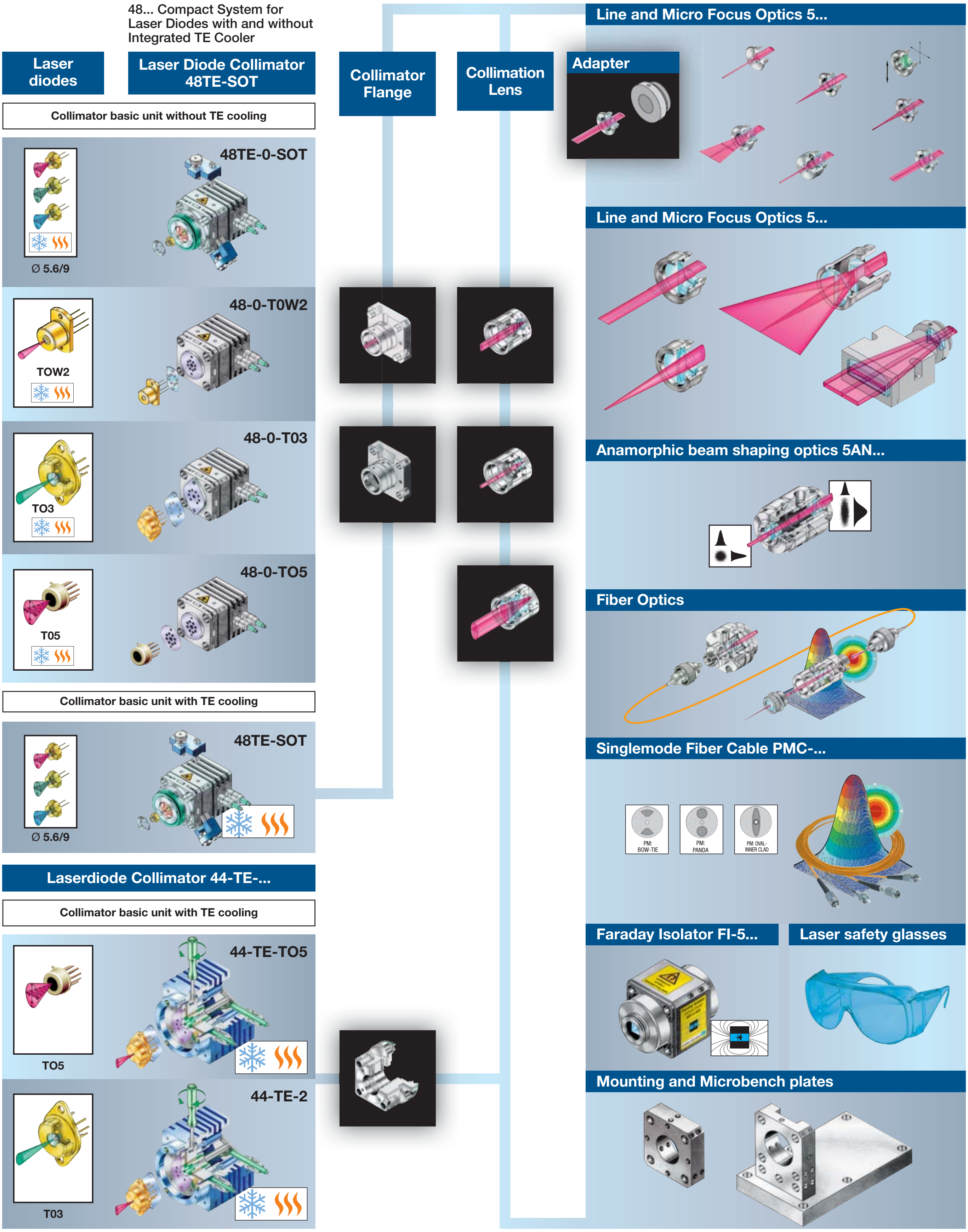


Laser Diode Collimators 48..., 44-...
Modular System for temperature-stabilized Laser Diodes

The Laser Diode Collimators of type 48... and 44-... are modular systems from **Schäfter+Kirchhoff** designed for laser diodes of the type Ø9, Ø5.6, TOW2, TO3, TO5 and TO46. The core laser diode systems can be supplied with Peltier elements or without integrated thermoelectric cooling. They are compatible with the microbench system and can be extended according to need using fiber connectors with the option, for example, of a Faraday Isolator to prevent to back-reflections of the laser beam.

These systems are provided for self-assembly but can be supplied preassembled and preadjusted according to customer requirements.



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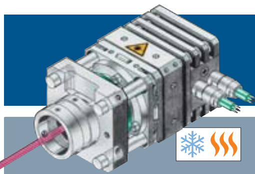
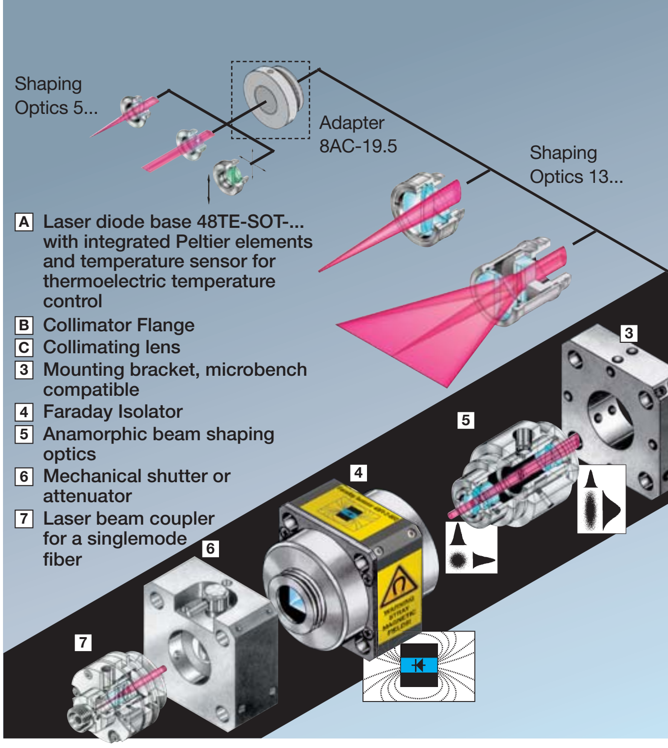
Schäfter+Kirchhoff

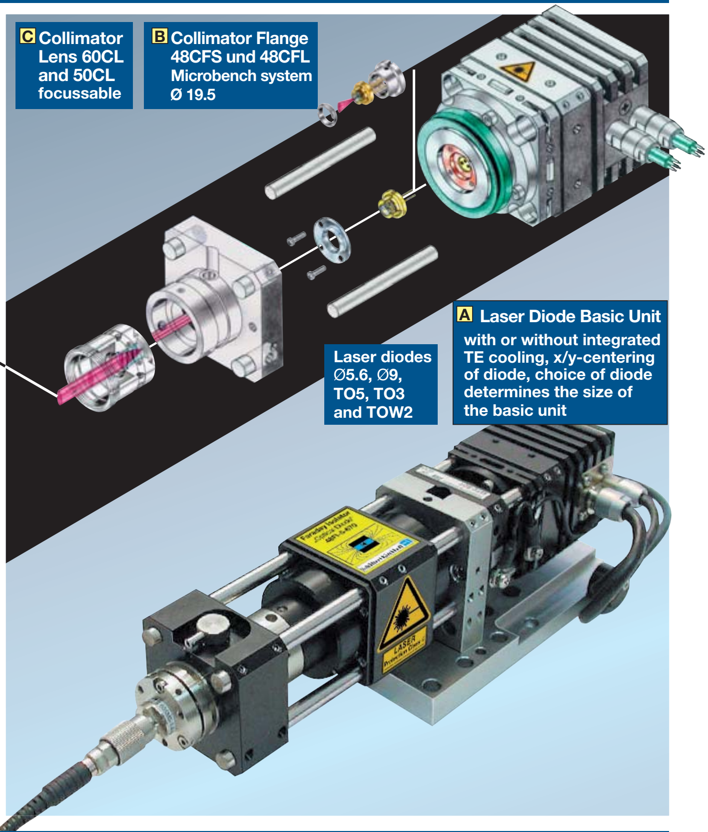
Laser Diode Collimators 48...



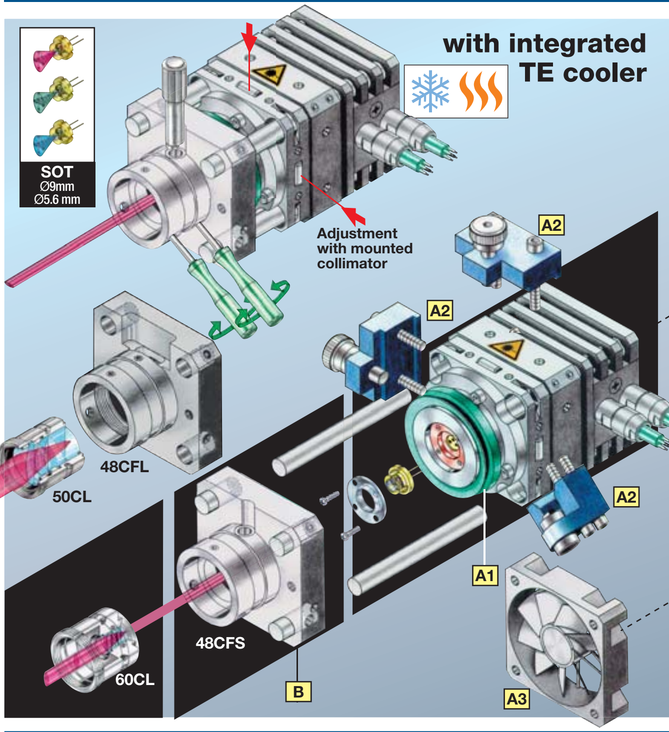
Universal modular system for self-assembly and adjustment based on the three functional elements: A B C



- A Laser diode base 48TE-SOT-... with integrated Peltier elements and temperature sensor for thermoelectric temperature control
- B Collimator Flange
- C Collimating lens
- 3 Mounting bracket, microbench compatible
- 4 Faraday Isolator
- 5 Anamorphic beam shaping optics
- 6 Mechanical shutter or attenuator
- 7 Laser beam coupler for a singlemode fiber



Laser Diode Collimator 48TE-SOT-...



Laser Diode Unit 48TE-SOT A

Main specifications:

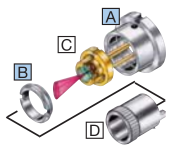
- x/y-centering of the laser diode onto the optical axis with adjustment tool 48AD
- Solderless spring-loaded connectors isolate the laser diode galvanically from the collimator casing
- Integrated Peltier element and temperature sensor for thermoelectric closed-loop control of the laser diode temperature
- Peltier element provides up to 2 W of heat transfer capacity $I_{max.}$ = 1.5 A, $U_{max.}$ = 2.8 V
- Temperature sensor: thermistor (NTC 10 kΩ)
- Separate connection cables for the power supply, the monitoring of the laser diode and temperature control
- Modular fan 48L A3 for increased thermal transfer efficiency (The 12V DC/0.1A power supply is not designed for use with vibration-sensitive applications)
- Microbench compatible (30 mm spacing)
- The components are adjusted and locked into place using radially located grub screws
- An elastomere diaphragm A1 encloses the laser diode, to prevent laser light from exiting and dust contamination

Adapters for Laser Diodes Ø 5.6 mm

Application: Laser diodes of Ø 5.6 mm size can be inserted into the retainer for laser diodes of Ø 9 mm size without altering the active area nor its position: the laser diode beam axis and the position of the emitter are unchanged.

Adapter Order Code **50AL-5.6**

2 parts A outer housing Ø 9 mm
B Retaining ring for laser diode
C Laser diode with housing Ø5.6 mm
D **Assembly key** Order Code 50LD5.6



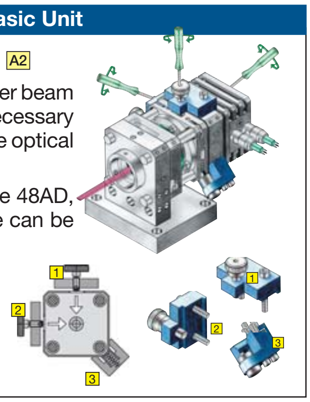
x/y-Centering of the Laser Diode Basic Unit

Adjustment fixture Order Code 48AD A2

For the optimum collimation of the laser beam free from aberration (e.g. coma), it is necessary to launch the emission center onto the optical axis of the collimator optics.

With the tripartite x/y-centering fixture 48AD, the mounting plate of the laser diode can be adjusted laterally.

Lateral displacement is performed using screws 1 and 2, while screw 3 provides the necessary counteractive force.



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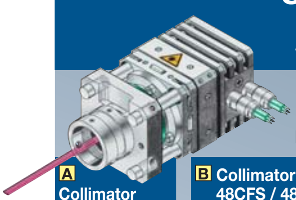
Laser Diode Basic Unit 48-0-... without integral TE Cooling

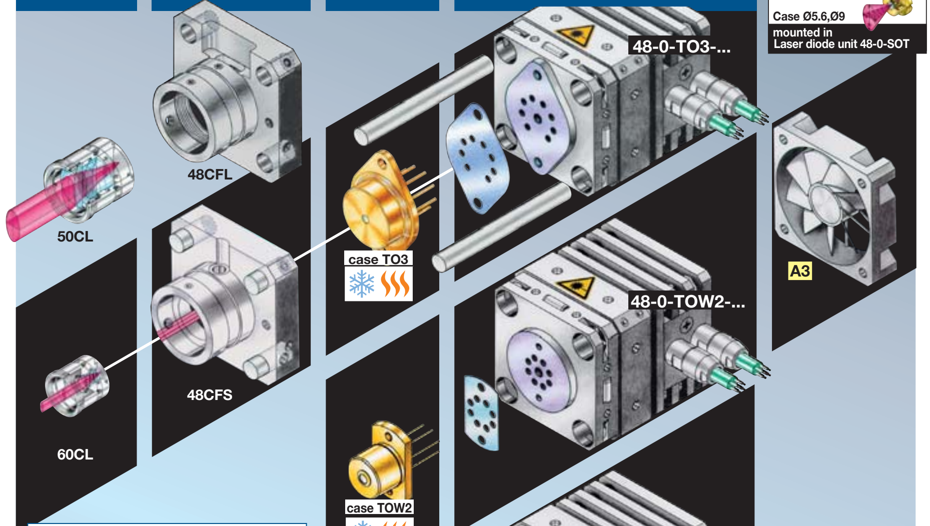
For diodes in casing Ø5.6, Ø9, TO3, TOW2 and TO5 with integral thermoelectric cooling



Universal modular system for self-assembly and adjustment based on the three functional elements: A B C

A Collimator Objective 60CL focussable	B Collimator flange 48CFS / 48CFL Microbench system Ø 19.5	Laser diode with integrated TE Cooling	C Laser diode base unit 48-0-TO3-... 48-0-TO5-... 48-0-TOW2-... 48-0-SOT-... x/y centering of the laser diode

Laser diodes 370–2300 nm
Laser diodes with integrated TE-Cooler: Laser diode Case TO3 mounted in Laser diode base 48-0-TO3
Laser diode Superlum Case TOW2 mounted in Laser diode base 48-0-TOW2
Laser diode VCSEL Case TO5 mounted in Laser diode unit 48-0-TO5
Laser diode Case Ø5.6,Ø9 mounted in Laser diode unit 48-0-SOT



Typ 48...

For the successful ordering of a Laser Diode Collimator Type 48 ... please select:

1. the laser diode (page 94)
2. the requisite laser diode base unit C (depends on diode module and TEC option)
3. the collimator optics A (page 86) according to wavelength choice and size of the unit (50CL or 60CL)
4. the collimator flange B appropriate to the collimation optics (page 86)

and then from the following options:

- fan 48L
- Beam-Shaping Optics, series 5 or 13
- consoles and mounting brackets (page 72)
- anamorphic correction (page 87)
- Faraday Isolator (page 88)
- Fiber Optics (see Fiber Optics catalog)
- adjustment tools and equipment

All of these items require separate order numbers to ensure completion of the order successfully.

Laser Diode Base Unit 48-0-... A

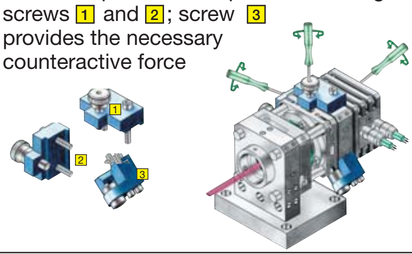
Main specifications:

- x/y-centering of the laser diode onto the optical axis with adjustment tool 48AD
- Solderless spring-loaded connectors isolate the laser diode galvanically from the collimator casing
- Separate connection cables for the power supply, for data transfer and monitoring of the laser diode and for temperature control
- Temperature sensor: thermistor (NTC 10 kΩ)
- Modular fan 48L A3 for increased thermal transfer efficiency (12V DC-0.1A power supply is not designed for use with vibration-sensitive applications)
- Microbench compatible (30 mm spacing)
- The components are adjusted and locked into their final position using radially located grub screws
- Microbench compatible

x/y-Centering of the Laser Diode Base Unit

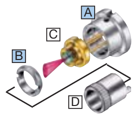
Adjustment fixture Order Code 48AD A2

Lateral displacement is performed using screws 1 and 2; screw 3 provides the necessary counteractive force



Adapter for Mounting Laser Diodes Ø5.6 /3.8 mm

Laser diodes of Ø 5.6 / Ø 3.8 mm size can be inserted into the slot for laser diodes of Ø 9 mm size without altering the active area nor its position: the laser diode beam axis and the position of the emitter are unchanged.



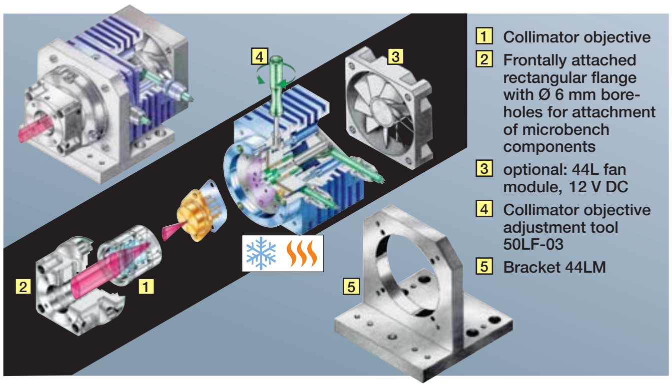
Adapter Order Code **50AL-5.6**
2-parts: A Outer casing Ø 9 mm
B Retaining ring for laser diode

Adapter Order Code **50AL-3.8**
2-parts: A Outer casing Ø 9 mm
B Retaining ring for laser diode

C Laser diode with casing Ø5.6 mm / Ø3.8 mm
D **Assembly key** Order Code **50LD5.6**

Adapters for other diode casings on request

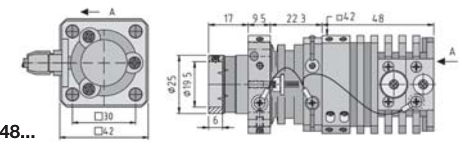
Laser Diode Basic Unit 44TE-...

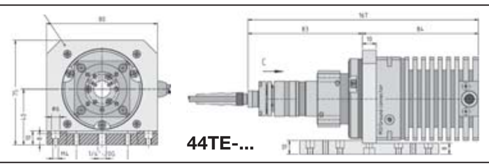


1. Collimator objective
2. Frontally attached rectangular flange with Ø 6 mm bore-holes for attachment of microbench components
3. optional: 44L fan module, 12 V DC
4. Collimator objective adjustment tool 50LF-03
5. Bracket 44LM

- Electrical isolation of the laser diode from the collimator casing using a spacer.
- Temperature sensor: thermistor (or alternative upon request).
- Separate electric cables for thermo-regulation, power and data.
- A solderless spring-loaded for the laser diode isolates it galvanically from the diode casing.
- Peltier element with a 15 watt heat transfer capacity (I_{max} +3.9 A, U_{max} 11.5 V).
- x/y-adjustment range of the laser diode by up to 0.5 mm
- Adjustable and focussable encasement of the collimator objective. A left or right-hand turn of the collimator objective provides a fine-focussing and colllimation of the laser beam, even with extraneous beam-shaping optics attached.
- The beam-shaping optics and singlemode fiber connector have the requisite cylindrical shape and V-groove for attachment to the collimator casing. The optical attachments can be adjusted radially and are locked into place with the radially located grub screws.

Dimensions





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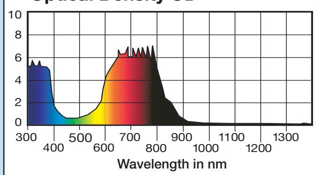
Safety at Work

Full Protection Goggles
DIN EN 207

Order Code **F18.P4H03.1001**

VLT = 10%

Optical Density OD



Usable Range					
Pro-tection	**Wavelength [nm]**	**Pro-tection Level**	**max. Trans-mission (EN 207)**	**max. Power Density (EN 207)**	**max. Power (EN 208)**
Full	620 - 660	LB3	10^{-3}	10^4 W/m²	-
Full	660 - 670	LB4	10^{-4}	10^5 W/m²	-
Full	670 - 710	LB5	10^{-5}	10^6 W/m²	-
Full	710 - 770	LB4	10^{-4}	10^5 W/m²	-
Full	770 - 820	LB3	10^{-3}	10^4 W/m²	-

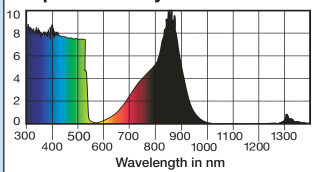
Full protection goggles for cw lasers in the 620 - 820 nm wavelength range

Full Protection Goggles
DIN EN 207

Order Code **F18.P1L02.1001**

VLT = 30%

Optical Density OD

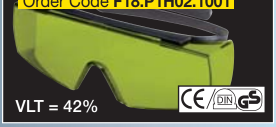


Usable Range					
Pro-tection	**Wavelength [nm]**	**Pro-tection Level**	**max. Trans-mission (EN 207)**	**max. Power Density (EN 207)**	**max. Power (EN 208)**
Full	>315 - 532	LB6	10^{-6}	10^7 W/m²	-

Full protection goggles for cw lasers in the 315 - 532 nm wavelength range

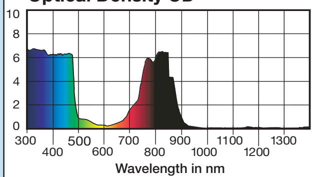
Full and Alignment Protection Goggles
DIN EN 207 / DIN EN 207

Order Code **F18.P1H02.1001**



VLT = 42%

Optical Density OD



Usable Range					
Pro-tection	**Wavelength [nm]**	**Pro-tection Level**	**max. Trans-mission (EN 207)**	**max. Power Density (EN 207)**	**max. Power (EN 208)**
Alignment	660 - 675	RB2	-	-	100 mW
Full	700 - 820	LB5	10^{-5}	10^6 W/m²	-

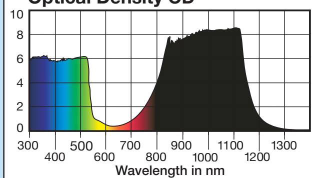
Alignment protection goggles are for lasers in the 660 - 675 nm wavelength range
Full protection goggles for the 700 - 820 nm wavelength range

Full and Alignment Protection Goggles
DIN EN 208/DIN EN 207

Order Code **F18.P1H01.1001**

VLT = 35%

Optical Density OD



Usable Range					
Pro-tection	**Wavelength [nm]**	**Pro-tection Level**	**max. Trans-mission (EN 207)**	**max. Power Density (EN 207)**	**max. Power (EN 208)**
Full	770 - 800	LB4	10^{-4}	10^5 W/m²	-
Full	800 - 1100	LB5	10^{-5}	10^6 W/m²	-

Full protection goggles for lasers in the 315 - 532 nm wavelength range

Laser safety and laser adjustment goggles

The use of laser safety goggles is recommended when working with lower power lasers from laser protection class 3R and beyond, such as all visible lasers from Schäfter+Kirchhoff with up to 5 mW of output power.

Laser safety goggles are mandatory for protection class 3B and beyond, such as all invisible infrared lasers and all visible lasers from Schäfter+Kirchhoff with more than 5 mW of output power.

The correct handling and use of the laser safety goggles protects you and your colleagues against eye injuries from hazardous laser radiation.

A selection of CE and GS certified laser safety goggles (manufactured by LaserVision, www.lvg.com) are provided for the lasers manufactured by Schäfter+ Kirchhoff.

The type of frame is dependent upon whether glass or plastic filters are fitted. Laser safety goggles with glass filters (Order Code **RX7**) have a heavier frame with a facility for attaching personal spectacles, according to individual requirements. Laser safety goggles with plastic filters are lighter and can be worn over normal spectacles.

The two distinct protective functions of either **full protection goggles** or **alignment protection goggles** need emphasizing (see box below).

Laser Safety Goggles - Function and Characteristics

Protective function. Full protection goggles and alignment goggles provide different levels of safety and laser protection.

Full protection goggles, conforming to European standard EN 207, provide personal protection against laser radiation. The laser radiation is blocked and is no longer visible.

The **protection levels** (such as protection level LB..) differ in the maximum spectral transmission of the filter glasses. The EN 207 standard specifies a maximum incident laser power density (power per unit area, in W/m²) for the laser power that is allowed to irradiate the filter glass.

Alignment protection goggles, conforming to European standard EN 208, reduce the visible laser radiation (400 - 700 nm wavelengths) to that of the power of laser class 2 (EN 60825-1). The laser radiation remains visible so as to allow the alignment protection glasses to be used for adjustment tasks while offering significant laser protection safety.

The **protection levels** (protection level RB..) describe the maximum power (watts) of a collimated laser beam that is allowed to irradiate the goggles.

Maximum power (EN 208): the maximum power of a laser beam in a specified wavelength range that is sufficiently attenuated by the alignment protection goggles (in accordance with EN 208).

Maximum transmission (EN 207): maximum transmission (minimum attenuation) in a specified wavelength range (according to EN 208).

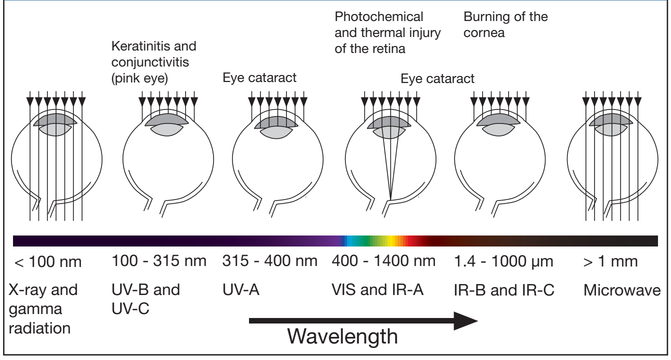
Maximum power density (EN 207): maximum power density that the filter glasses can withstand over a longer period (according to EN 207).

VLT: (visible light transmission): in addition to the specified wavelengths, laser protection goggles also attenuate the ambient light. The VLT is the percentage of daylight transmitted.

OD (optical density): logarithmic scale for the attenuation of radiation at a specified wavelength. The *OD* at wavelength λ is defined as:

$$OD(\lambda) = -\log_{10} \tau(\lambda)$$

Types of Damage Caused to Eyes by Radiation



Insert for Spectacles

Order Code **RX7**

As an accessory for the laser protection goggles of type R01.T1A01 and R01.T1Q01, the insert RX7 for personal spectacles is available.

Please Note Typical density curves for the respective filters are shown for information only and are not guaranteed values. Only the protection levels (RB.. or LB..) are guaranteed by Schäfter+Kirchhoff.

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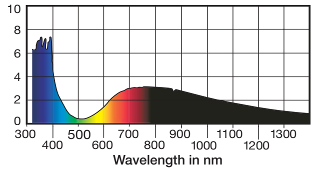
Laser Alignment Goggles

Full Protection Goggles
DIN EN 207
Order Code **R01.T1A02**

VLT = 25%

Optical Density OD

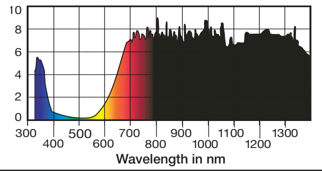


Usable Range					
Protection	Wavelength [nm]	Pro-tection Level	max. Trans-mission (EN 207)	max. Power Density (EN 207)	max. Power (EN 208)
Alignment	630 - 690	RB2	-	-	100 mW
Alignment protection goggles for cw lasers in the 630 - 690 nm wavelength range					

Full Protection Goggles
DIN EN 207
Order Code **R01.T1Q01**

VLT = 35%

Optical Density OD



Usable Range					
Pro-tection	Wavelength [nm]	Pro-tection Level	max. Trans-mission (EN 207)	max. Power Density (EN 207)	max. Power (EN 208)
Full	690 - 1320	LB5	10^{-5}	10^{6} W/m²	-
Full	1320 - 1550	LB2	10^{-2}	10^{3} W/m²	-
Allround googles as full protection for cw lasers in the 690 - 1500 nm wavelength range					

Laser Safety

According to DIN IEC 60825-1:2007, every laser system must be labelled with a **warning triangle**.
Additionally, all lasers must be labelled with additional **warning information** specific to the laser class:

If the laser is enclosed but the housing can be opened then the housing must also be labelled with a warning triangle and the requisite information about the laser class,
as listed below:

Class 1:
" CLASS 1 LASER PRODUCT "
Class 1M:
" LASER RADIATION, DO NOT VIEW DIRECTLY WITH OPTICAL INSTRUMENTS, CLASS 1M LASER PRODUCT "
Class 2:
" LASER RADIATION, DO NOT STARE INTO BEAM, CLASS 2 LASER PRODUCT "
Class 2M:
" LASER RADIATION, DO NOT STARE INTO BEAM OR VIEW DIRECTLY WITH OPTICAL INSTRUMENTS, CLASS 2M LASER PRODUCT "
Class 3R:
" LASER RADIATION, AVOID DIRECT EYE EXPOSURE, CLASS 3R LASER PRODUCT "
Class 3B:
" LASER RADIATION, AVOID EXPOSURE TO THE BEAM, CLASS 3B LASER PRODUCT "
Class 4:
" LASER RADIATION, AVOID EYE OR SKIN EXPOSURE TO DIRECT OR SCATTERED RADIATION, CLASS 4 LASER PRODUCT "

Class 1: The laser is safe for any form of measurement task and the maximum permitted exposure (MPE) cannot be exceeded. Enclosed high power laser systems, with an integrated automatic shutdown system on opening of the enclosure, are also included in this laser class.

Class 1M: As for class 1, except when magnifying optics such as microscopes and telescopes are used: safety limits may be exceeded and class 3 dangers may be possible.

Class 2: Visible laser light (400 - 700 nm) with <1 mW continuous wave (CW) and/or <0.25 s exposure time (with an energy limit according to the standard) is considered to be safe. Radiation either side of the 400 - 700 nm range is considered to be class 1.

Class 2M: As for class 2, except when magnifying optics such as microscopes and telescopes are used.

Class 3R: If handled carefully, the laser is considerd safe because only a low risk of injury exists. Visible CW lasers in Class 3R are limited to 5 mW. For other wavelengths and for pulsed lasers, other limits apply.

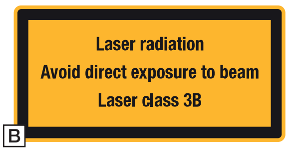
Class 3B: Direct exposure is hazardous for the eye, but diffuse reflections such as from paper are not harmful. The limits apply to wavelengths and to operation mode (as for CW and pulsed lasers). Laser safety goggles are absolutely required when a direct view of the laser beam is at all possible. Class-3B lasers must be equipped with a isolating key switch and a safety interlock.

Class 4: Every type of laser beyond class 3B.

Furthermore, all lasers of class 2 to 4 must have a warning that lists the laser specifications, including the laser source, the wave-length and the laser power or pulse energy.

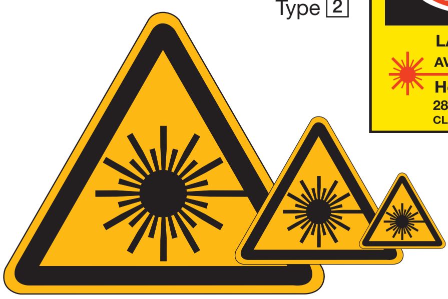
B

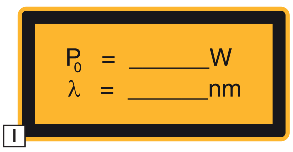
Type 1



B

Type 2





I

Order Code	Size
SK-LB-T1	Triangle 10 mm
SK-LB-T2	Triangle 46 mm
SK-LB-T3	Triangle 92 mm
SK-LB-T4	Triangle 185 mm

SK-LB - 3B - 633 - 25 - HeNe - 100x50 - BI - E Order Code

Laser classification
1, 1M, 2, 2M, 3R, **3B**
(see list above)

Wavelength [nm]

Laser power [W] or pulse energy [J]

Laser Type:
HeNe
Diode
Nd:Yag
others

Language:
E = English
D = German

Option:
E = Sign for removable enclosure
B = Basic information sign without specifications
I = Laser specification sign
BI = both B and I

Label size
105 x 52 mm type 1 . . **105x52**
148 x 74 mm type 1 . . 148x74
64 x 34 mm type 2 . . . . 64x34

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Schäfter+Kirchhoff

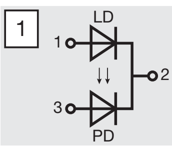
Laser Diodes for Modular Laser Diode Collimating Systems (page 77ff)

Table 1 Technical Data and Appropriate Collimator Types (Please note that laser diodes are not sold separately)

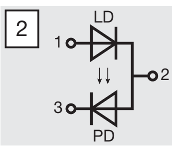
Row	λ [nm]	P [mW]	LD Order Code	Single-/ Multi-mode	$\theta_{\parallel\,FWHM}$ [°]	$\theta_{\perp\,FWHM}$ [°]	Casing	Pin-Out	25CM	55CM	90CM	29CM	95CM	40...-PO	40...-NO	48TE	48-0	20C, 20P	21C, 21P	22P	24PX	50BM	55BC
1	**Fabry Perot**																						
2	405	120	X15	S	9	19.5	5.6	F4	X	X	X					X		X	X	X	X		X
3	405	20	G05	S	8.5	19	5.6	1	X	X	X							X	X	X	X	X	X
4	515	25	X18	S	9	21.5	5.6	F4	X	X	X							X	X	X	X	X	X
5	635	15	H10	S	8	28	9	3	X	X	X							X	X	X	X	X	X
6	639	30	H18	S	8	31	5.6	3		X	X											X	X
7	640	45	H22	S	9	21	5.6	3	X	X	X							X	X	X	X	X	X
8	659	120	M25	S	10.2	16.5	5.6	6		X	X					X							X
9	660	35	M01	S	9	22	5.6	2	X	X	X							X	X	X	X	X	X
10	660	60	M26	S	8.5	20.5	5.6	2	X	X	X							X	X	X	X	X	X
11	685	35	M21	S	10.5	19	5.6	2	X									X	X	X	X		
12	685	50	H13	S	8.5	21	5.6	2	X	X	X							X	X	X	X	X	X
13	785	8	M10	S	11	29	5.6	3	X									X	X	X	X		
14	785	120	Q06	S	9	16	5.6	3		X	X											X	X
15	825	200	M35	S	8	16	5.6	1						X									
16	830	50	H19	S	9	22	5.6	2	X									X	X	X	X		
17	830	150	N23	S	8	16	5.6	2		X	X					X							X
18	1060	50	Q05	S	10	30	9	3	X	X	X							X	X	X	X	X	X
19																							
20																							
21	**CircuLaser™ Diodes**																						
22	635	5	B08	S	8	8	9	3				X	X					X	X	X	X	X	X
23	635	15	B07	S	8	8	9	3				X	X					X	X	X	X	X	X
24	639	35	B21	S	7.7	8	5.6	3				X	X					X	X	X	X	X	X
25	658	35	B09	S	8	8	5.6	2				X	X					X	X	X	X	X	X
26	658	130	B29	S	10	10	5.6	2				X	X										X
27	690	35	B12	S	8.5	8	5.6	2				X	X					X	X	X	X	X	X
28	785	90	B32	S	9	9	5.6	3				X	X					X	X	X	X	X	X
29	828	150	B16	S	7	7	9	3				X	X										X
30																							
31	**DFB / DBR** (S* narrow emission bandwidth because of integrated grating)																						
32	1065	120	FB02	S*	11.5	30	9	1							X		X						
33	1305	6	M06	S*	25	30	5.6	4							X	X							
34	1550	6	M15	S*	25	30	5.6	4							X	X							
35	1850	5	sold by manufacturer **	S*	30	50	TO5	4							X		X						
36	1900	5	sold by manufacturer **	S*	30	50	TO5	4							X		X						
37	2334	3	sold by manufacturer **	S*	20	40	TO5	4							X		X						
38																							
39																							
40																							
41																							
42																							
43	**Superluminescent Diodes**																						
44	679 ± 4	10	sold by manufacturer ***				9	2							X		X						
45	860 ±60	15	sold by manufacturer ****				TOW2								X		X						
46	650 ± 3	0.5	sold by manufacturer ****				TOW2								X		X						
47	**VCSEL**																						
48	760	0.3	sold by manufacturer *****	S	17±7		TO46	3							X	X							
49	780	2.5	sold by manufacturer *****	S			TO46	2							X	X							
50	850	8	sold by manufacturer *****	S	29	29	TO46	6							X	X							

** sold directly by nanoplus *** sold directly by Qphotonics **** sold directly by Superlum *****sold directly by U-L-M Photonics **Other diodes are available on request.**

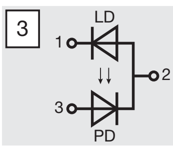
Connection Types and Pin-Out



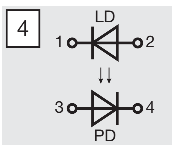
1 = LD anode
2 = LD cathode
PD cathode
case ground
3 = PD anode



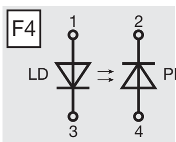
1 = LD anode
2 = LD cathode
PD anode
case ground
3 = PD cathode



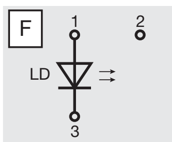
1 = LD cathode
2 = LD anode
PD cathode
case ground
3 = PD anode



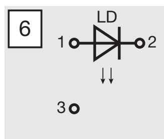
1 = LD cathode
2 = LD anode
case ground
3 = PD anode
4 = PD cathode



1 = LD anode
2 = PD cathode
3 = LD cathode
4 = PD anode



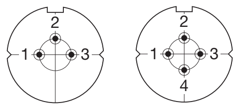
1 = LD anode
2 = n.c.
3 = LD cathode



1 = LD anode
2 = LD cathode
3 = n.c.

LD = laser diode
PD = photo diode

Example: Ø 9 mm LD package
Refer to LD data sheet for other types.



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